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THE EVOLUTION HOAX EXPOSED

(FORMER TITLE: WHY COLLEGES BREED COMMUNISTS)

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PREFACE

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Evolutionism is the subject which the author examines. It is a subject the implications of which are, for some, obscured by the rodomontade of certain scientists. More dangerously, the true character of evolutionism is clouded for many by the vapourings of professional religionists, and in particular by such as choose to dispense that peculiar mixture of clergianity and Marxism known as the Social Gospel. In the mass media of England, the T.V., the press and the wireless, evolutionism is sacrosanct, and its speculative basis must not be discussed. The more vocal propagandists of the cult, however, have been granted access to the schools and universities. It is as paid educationalists that these are now licensed to press their atheism upon captive audiences, and, where and whenever possible, to overthrow the faith of children.

In this compact survey, Mr. Field shows evolutionism to be a scientific fraud. He brings forward the facts which enabled him to recognise the modern university college as a machine for de-Christianising and demoralising the community.

In his chapter, Evolution's Offspring, the author opens up a very fruitful line of research, and reveals the origin of much of the spiritual and intellectual unrest of our times. This is generated by the wilful abandonment of Scripture; yet there are signs that the wheel is coming full circle. Again, one here, one there, is prompted to return to, and to dare to believe what God has written.

May this book play some part in encouraging that return.

THE PUBLISHERS.

CONTENTS

CHAPTER PAGE

I THEORY VERSUS REALITY, ... 9

False theory of evolution invades all sides of life—Subversion in universities—London and Harvard questionnaires—Our theory-ridden intellectuals—Injurious effects on national policy—League of Nations fiasco—Federal Union craze— root of trouble

II THE SKELETON IN THE CUPBOARD..... 12

Transformist ideas ancient—French Revolution and evolution —Darwin's theory—Glosses over lack of proof—Huxley more candid—Darwin's private admission—Later admissions —All evolution theories collapse—No new species producible —Breeding experiments fail

III EVOLUTION'S CASE TODAY..... 18

What is proof—Nose-counting—Encyclopaedia says evidence overwhelming—A changed tune—Common plan no proof— How Darwin distributes species—Imagined origin of life— Useless organs prove useful—Nascent organs unknown— Embryology fades away.

IV FOOTPRINTS ON THE SANDS OF TIME 24

What the fossils show—Succession, not transition—Earliest life fully developed—Missing links still missing—Only minor modification seen—The famed horse fossils—Earliest plants unchanged—Insects remain insects—Darwinians say fossil-isation a miracle—Statistics show otherwise—Magical transformations—The whale.

V THE MONKEY-MAN FABLE..... 32

A libel on mankind—Neanderthal Man—Rhodesian man— Heidelberg man—Java man—Chimpanzee skull cap and human thigh-bone sorted from bone heap—withheld facts— Discoverer now discards as an ape—Piltdown man a conjecture—Peking man is Java man without human thigh— True man older than any missing link—How the public is hoodwinked—American monkey-man proves to be a pig— Tennessee anti-evolution case.

VI How EVOLUTION WAS BORN.....44

Not observed in nature—Darwin gets basic idea out of a book— Forestalled by A. R. Wallace with same idea from same book —Malthus on Population—Malthus gets his idea from Benjamin Franklin—Voltaire the supposed originator—Political economy, Marxism, birth control, and evolution based on idea of population increasing faster than food supply— Modern research finds no pressure of animals on food supply —No case of natural selection known—Inutility of specific characters belies evolution—A scientific fraud—Darwin's minor theories collapse.

VII FROM BOOM TO RACKET 52

Darwin's astounding success—Reasons for it—French Institute resists—Fleeming Jenkin picks a hole—Darwin patches it up—"The master art of wriggling"—Sir R. Owen "mad with envy"—Mivart annoys Darwin—Darwin's nose proves case—Sedgwick condems his materialism—Agassiz on the weakest spot—American science council says evolution is established fact—Disbelieving scientists now outlawed—No billets for such—Press and book trade captured—B.B.C. bans anti-evolution and admits communism.

VIII ALL ABOARD FOR ATHEISM 61

Evolution empties the churches—Mainstay of materialism and atheism—Darwin and Huxley abandon religion for evolution—Their theological views—No design in living things— Dice-box aids research—Pleasure the basis of morality— Huxley worried for his family—Rationalist Press Association —No evidence of religion—Less of evolution—Materialism and credulity—Knowledge versus values—The real test.

IX EVOLUTION'S OFFSPRING 69

Evolution as sales talk for revolution—Spencer's evolutionist philosophy—The theory will not fit inorganic nature—This fact dodged—Huxley on man's ascent by cunning and brutality—Nietzsche's Prussianistic philosophy based on Darwin—Socialism and evolution—Socialism's borrowed moral principles—Evolutionist worship of Bolshevism— Bolshevism reciprocates—Psycho-analysis based on monkey-man belief—Determinism and Behaviourism likewise— Sedgwick's warning recalled.

X WHAT SCIENCE IS FINDING.....77

Evolutionists themselves undermining theory—Darwin on mutability of species—Modern science impressed by their constancy—Evolution's crazy chronology—Years by the thousand million—Nature's endless individual variety— Present view of species—The units of creation—Early Christian teaching—Evolution leaves science for theology— Scientists' leanings prevent neutrality—Strong atheistical background in incubation of theory.

XI MAN AND CIVILISATION 85

Archaeologists find no primitive beginnings to civilisation— Decay more common than progress—Anthroplogists report savage races provide no evidence of upward evolution—Much evidence of retrogression—Diffusionists say all early culture spread from a common centre—All notion of evolution in human history rejected—No increase in man's mental powers—Civilisation only occurred twice—Progress due to exceptional individuals—How decay can come—Evolution applied to history minimises value of individual effort: everything due to environment—Socialist-evolutionists say able and industrious men not entitled to full produce oi their labour—Their ability and energy a product of evolution— Research shows human ability due to heredity and not environment—What intelligence tests reveal—No surplus of ability—Value of family tradition—Present-day policies counter to facts.

XII CONCLUSION 96

Evolution a fundamental fallacy—A revival of the atheism and revolutionary ideas preceding French Revolution—That event engineered by hidden forces—Those forces very ancient —"Satanism and the World Order"—Britain's downfall the present object—Naturalism versus Supernaturalism—Barren results of revolution—A Russian writer's view of mankind's alternatives—New Zealand schools closed to Christianity but open to de-Christianising evolution—Government's out-of-date ideas on latter—Oxford book on human evolution—Social worthlessness of University influence.

APPENDIX 102

Scientists who reject evolution.

Chapter I

THEORY VERSUS REALITY

THE PURPOSE of this book is to show the falsity of a theory which for three-quarters of a century has dominated all British thought. Nominally, the theory of organic evolution is no more than a proposition in biological science. Actually, it is the parent and support of a whole host of subsidiary theories—political, economic, and scientific—all accepting as established truth things which are wholly unproven, and many of which are demonstrably untrue.

On evolution's twenty-first birthday in 1880, Thomas Huxley, chief propagandist of the Darwinian gospel, remarked that it was "the customary fate of new truths to begin as heresies, and to end as superstitions (Huxley's Life and Letters, ii, 12). Evolution, disguised as truth, has run this full course. In the light of all the facts it is no overstatement to say that it has made the universities and higher educational institutions of the British Empire, not centres of enlightenment but haunts of superstition and intellectual darkness. The theory of evolution is only kept going by constant distortion of observed fact, and its main result is wrong-headed thinking on all aspects of life.

In the universities of Britain, the British Empire, and the United States a strong under-current of subversive influence has been operating on the minds of students for many years past. Many people who have never had occasion to look into the matter closely regard this as due to nothing more than misguided ebullitions of youthful enthusiasm. There is evidence, however, of organised effort over many years in the work of deliberately pumping subversion into Britain's universities. Even a generation back it was recognised in New Zealand that the little trickle of university professors from Britain was bringing with it a steady insinuation of materialistic and subversive ideas into the minds of students. Since the outbreak of the present war public feeling on the matter has found emphatic expression in some parts of New Zealand. Evolutionist teaching prepares the ground for subversion.

It is well recognised that this mental infection is apt to colour the whole outlook on life of those who suffer it. Two professors of the University of London in 1933 were so impressed by this that they set out to collect statistics as to how far students supporting one "advanced," "progressive," or "unorthodox" movement tended to

support other such movements. The questionnaire did not inquire if the students believed in evolution, for this is nowadays taken for granted. According to the London Patriot of May 25, 1933, the numerous movements listed in the professorial questionnaire included birth control, abortion, sexual freedom, new education (without coercion), rationalism (atheism), nudism, psycho-analysis, anarchism, communism, socialism, refusal of military service, sterilisation, etc., etc. The universities were not established as hotbeds of propaganda for movements of the above character, but have become such.

In the United States in 1934 a somewhat similar questionnaire was circulated by an undergraduate organisation of Harvard University, the numerous questions in the forms distributed being, however, almost wholly on psycho-analytic sex lines with inquiry into students' views and habits (Boston Evening Transcript, March 14 and 15, 1934). These two inquiries bear sufficient testimony to a similar trend of infection in leading educational institutions in both Britain and the United States.

The practical outcome of university education today is the production of people with a boundless belief in all manner of unverified, and often unverifiable, theories. At the same time the general public is inspired with an equally boundless, and equally groundless, belief in anything labelled as Science. Experience is thrust out of the window as a useless teacher, and some little tom-noddy of a university graduate with a bagful of theories is blindly entrusted with the task of remaking heaven and earth.

In world affairs we see the fruits of modern university education in the present difficulties in which the British Empire finds itself involved, and from which the fortitude and resolution of the common people are left to extricate it. Throughout the nineteenth century, before the theorists took charge, British foreign policy was based on intelligent and practical principles. Ample armed force and minimum interference in European affairs was the rule. And long stretches of almost unbroken peace were the result.

At the end of the World War in 1918 our educated theorists got the bit properly between their teeth, and the edifice known as the League of Nations was exactly the sort of product to be expected from university-minded people. This scheme for the manufacture of peace on earth was all theory without any working parts whatever. Its principal promoter in the British Ministry during the last war got a Foreign Office report in 1916 on the draft plan, which report by Sir Eyre Crowe duly pointed out in detail that the projected League would do everything except operate as desired. This trifling shortcoming, however, was held in no way to detract from the theoretical beauty of the plan for remaking mankind. This text of this instructive report will be found in the Lloyd George War Memoirs (vol, iii).

In their worship of this Palace of Talk at Geneva our evolutionist

university-minded intellectuals were prepared to neglect and sacrifice every British interest. The clamour of these theorists resulted in Britain first throwing away her arms, and then entangling herself in every possible and impossible direction in other people's business in Europe and elsewhere.

After four years of suffering and endurance by the common people, the British had emerged victorious from the last war. All the fruits of victory were flung away by the theorists. An amazing financial policy was pursued at the bidding of a private corporation of secret and possibly foreign ownership: and the result was unemployed workers by the million over a period of twenty years—exactly as was predicted in the London Times in 1918 on the policy being first mooted. No effort worth speaking of was made to develop the nation's world-wide heritage. A great part of the time of the political heads was taken up in rushing from one international conference to the next, and signing pact after pact, each of which duly proved worthless almost before the ink was dry on it.

In the end, this twenty years of unreal politics based on unreal education collapsed like the house of cards it was. Britain found herself plunged into war under more disadvantageous circumstances in point of equipment and allies then ever before in her history. In this struggle the mass of the nation as before is exhibiting the high qualities of the British race.

As for the intellectuals, they have made the war the occasion for producing an even more flamboyant theoretical construction than their League of Nations Plan of the last war. Under the name of Federal Union this proposes a restoration of the gold standard for the benefit of the international financiers owning the world's gold stock; the dissolution of the British Empire; and, for all practical purposes, its virtual absorption by the United States. This remarkable project the present writer hopes to review at a later date.

Such are the fruits of our theory-mad age. And the fountain-head of these dreams and imaginings, divorced from reality is undoubtedly the theory of organic evolution produced by Charles Darwin just over eighty years ago. This is the grand river of falsity and corruption from which all sides of national life have been irrigated with the waters of untruth. The effects of this theory are so far-reaching that they deserve the attention of all. In the following pages we will trace out the present position of the case for evolution, the origin and development of the theory, and some of its consequences.

Chapter II

THE SKELETON IN THE CUPBOARD

WITH oaks to be seen sprouting from acorns, grubs turning into butterflies, and chickens pecking their way out of eggs, it is not surprising that human fancy from an early date toyed with the notion of one kind of living thing being transformed into some other kind. This idea has been the stock-in-trade of folk-lore and fairy tales in all ages and all lands. It was the achievement of Charles Darwin to make it the foundation of modern biological science.

At the end of the eighteenth century there occurred that great event known as the French Revolution, described in various quarters as a landmark in the liberation of the human spirit. Incidentally, the student may learn from Alison's History of Europe how in the course of this episode the mob in the streets of Paris roasted and ate the bodies of the massacred Swiss Guard of the royal palace on August 10, 1792, and how fifteen months later the multitude assembled in the Cathedral of Notre Dame to worship the Goddess of Reason, personified by an actress, also well known to the public in another capacity, placed naked by Government decree upon the altar of the French Westminster Abbey. State and people having alike discarded Christianity as outworn superstition, attention was directed in scientific circles to discovering how the world had come into being without intervention of the Almighty.

Modern evolutionist theory dates from the writings of two French scientists of this period, the Comte de Buffon and M. Lamarck, the latter of whom propounded a theory of evolution by inheritance or acquired characters. Evolutionist ideas were also advanced in England by a medical man and author of Derby, Dr. Erasmus Darwin, correspondent and admirer of Jean Jacques Rousseau, chief philosopher of the French revolutionary era. Ideas of evolution began to float about, and in 1813, Dr. W. C. Wells aired the subject before the Royal Society in London.

Scientists in the first half of the nineteenth century were by no means all believers in Evolution. The Creationists were in a great majority, and the Evolutionists lacked a plausible theory of how evolution had occurred. This was all altered on the appearance of Charles Darwin's Origin of Species in 1859.

Darwin's theory was that all species had evolved from primal protoplasm by Natural Selection, or survival of the fittest in the struggle for existence. As lambs still continued to appear with tails, despite the fact that their parents had had theirs cut off for generations back, Lamarck's idea of evolution by inheritance of acquired characters had failed to convince. Darwin not only provided a more attractive theory but he elaborated it in a big book. He directed attention to the way breeders of domestic animals and plants got new varieties by selective breeding. He quoted instances of small variations occurring in all directions in living things. He argued that the rate of multiplication of living things produced an intense struggle for existence exterminating those with unfavourable variations and permitting those with favourable variations to nourish and increase.

The idea of evolution as thus propounded met with immediate and astounding success. Not all scientists accepted it by any means, but it caught on and disbelievers were soon shouted down. In his presidential address to the British Association for the Advancement of Science in 1937 Sir Edward Poulton said the records showed that Dr. Wright back in 1881 was the last person to express disbelief in evolution at this British scientists' parliament. The article on evolution in the current (1929) edition of the Encyclopaedia Britannica affirms evolution to be an established fact supported by "overwhelming" evidence. In current newspaper and magazine literature evolution is similarly treated as a fact beyond dispute, and in colleges and schools is usually rammed down the pupils' throats as incontrovertible truth.

Nevertheless, there is a small, slight hiatus in the argument. There is, unfortunately for evolutionists, not a shred of evidence of any living thing ever evolving into some different kind of living thing capable of breeding but infertile with its parent stock. All that breeding experiments have produced is mere varieties fertile with their parent stock, or else sterile hybrids, incapable of breeding, such as the mule produced by a cross between horse and donkey. All living things go on obstinately producing young after their own kind and no other kind. Evolution has to show that living things can break through their natural breeding limits. And this is just what evolution has been quite unable to show.

This small defect in an otherwise pleasing theory Darwin glossed over in his books. Nevertheless, Darwin admitted in the introduction to his Origin of Species that evolution as a scientific theory "would be unsatisfactory, until it could be shown how the innumerable species inhabiting this world have been modified." Before he got to the end of his 700 pages Darwin ignored this requirement, for, without meeting it, he declared himself in his concluding chapter "thoroughly convinced" of evolution.

Huxley, who from the outset constituted himself the chief propa gandist of Darwinism, was more logical. He made no bones about the total absence of any actual proof of evolution. In fact, he greatly annoyed Darwin by harping on the point, as anyone who cares to peruse the five volumes of Darwin's letters and the two volumes of Huxley's may discover for himself. " My God," wrote Darwin to Huxley in 1862, "is not the case difficult enough without its being, as I must think, falsely made more difficult. I believe it is all my own fault—my own d --------- d candour . . ." (More Letters of Charles Dar win, i, 230).

This outburst was in consequence of Huxley having pointed out in his lectures and books that so far it had not been possible by selective breeding to produce a form capable of breeding but infertile with the parent stock. Huxley, in admitting this lack of evidence, said in his Edinburgh lectures in 1861 that if it could be shown that such failure was "the necessary and inevitable result of all experiments" he would hold Mr. Darwin's hypothesis to be "utterly shattered." (Man's Place in Nature, Everyman edition, p. 256). He added, however, that he looked for early proof to be forthcoming. In a letter to Darwin, Huxley said he told his students that he was satisfied that twenty years' scientific breeding experiments with pigeons would provide the necessary proof (Huxley's Life and Letters, i, 195-6).

Although so heatedly rebuking Huxley in 1862, Darwin himself eight months later, privately admitted in a letter to Dr. Bentham the total absence of any proof of evolution. This is what he wrote under date of May 22, 1863 : "In fact belief in Natural Selection must at present be grounded entirely on general considerations. . . . When we descend to details, we can prove that no one species has changed (i.e., we cannot prove that a single species has changed); nor can we prove that the supposed changes are beneficial, which is the groundwork of the theory. Nor can we explain why some species have changed and others have not" (Darwin's Life and Letters, iii, 25).

Darwin died in 1882. Huxley died in 1895. Four years before he died Huxley wrote to Professor Romanes that evolution still stood without the evidence on which he had insisted thirty years before. He had always insisted, he said, on "the logical incompleteness of the theory so long as it was not backed by experimental proof" (Huxley's Life and Letters, ii, 291).

We now pass onwards another thirty years; and we find the noted English evolutionist, Professor Sir William Bateson, acknowledg ing exactly the same total absence of any proof of evolution. This is what he said to the congress of the American Association for the Advancement of Science in Toronto in 1921 :—

"When students of other sciences ask us what is now currently believed about the origin of species we have no clear answer to give...

The conclusion in which we were brought up, that species are a product of summation of variations, ignored the chief attribute of species, that the product of their crosses is frequently sterile in great or less degree. Huxley very early in the debate pointed out this grave defect in the evidence, but before breeding researches had been made on a large scale no one felt the objection to be serious. Extended work might be trusted to supply the deficiency. It has not done so, and the significance of the negative evidence can no longer be denied" (Nature, Ap. 29, 1922).

Six years later another prominent evolutionist, Professor J. B. S. Haldane, in his book Possible Worlds (p. 38) said in 1927 : "The barrier of inter-specific sterility is the most serious argument against Darwin's Organic Evolution." It is equally a barrier against any other kind of organic evolution.

In 1931 we find the great Professor H. F. Osborn, of the United States, described by Britain's Royal Society as the greatest palaeontologist of the day, making the following remarkable statement to a congress of the British Association :—

"We are more at a loss than ever to understand the causes of evolution. One after another the Buffonian, Lamarckian, Darwinian, Weissmannian, and De Vriesian theories of causation have collapsed ... All that we can say at present is that Nature does not waste time or effort with chance or fortuity or experiment, but that she proceeds directly and creatively to her marvellous adaptative ends of biomechanism" (Nature, September 28, 1931).

This is an admission by one of the high priests of science that all theories of evolution have collapsed. Buffon propounded a general theory of evolution; Lamarck, tutor to Buffon's children, followed with an idea of evolution by inheritance of acquired characters; Darwin advanced the idea of gradual small changes by natural selection; Weissman put all the emphasis on the germ plasm; and De Vries-put forward the idea of evolution by mutations or sudden large variations.

Two years later on again Professor James Ritchie, the great zoologist of Edinburgh University, wrote in Nature of September 30, 1933 : "The problem of the origin of species seems to be as far from solution as ever." In September, 1939, Professor Ritchie delivered the presidential address to the zoological section of the British Association and had nothing further to report. "The existence of life," he said, "must be considered as an elementary fact which cannot be explained," and, admitting life, the biologist "may build up a whole body of biological theory . . . logical in the logic of probability . . ." (Nature, September 23, 1939). Everything was down to mere shadowy "probability."

The above series of pronouncements by front-rank biologists covers the entire period of eighty years since the first proclaiming of the Darwinian gospel. There is no more vestige of proof of evolution today than there was in those early days when Darwin privately, and Huxley openly, admitted its total absence.

Claims are made from time to time of the production by experiment of new species of living things, but they rapidly drop out of sight and the above series of statements at scientific headquarters is sufficient evidence that no such claim has survived examination. This evidence is vital to the evolution theory, and if it were forthcoming we may be quite sure it would be proclaimed from the house-tops for all the world to hear.

If this evidence is lacking it is not for want of seeking it. For example, a whole literature, so extensive that a bibliography of it was recently published, has grown up about the breeding experiments with the pumice fly Drosophila melanogaster. Mr. Douglas Dewar, a Fellow of the Zoological Society and one of the few British biologists rejecting evolution, in his Challenge to Evolutionists (pp. 20-21) relates how in 1910 Morgan and his collaborators hit upon the idea of experimenting with this quick-breeding fly.

This obliging little creature produces 25 generations a year at ordinary temperatures and more at higher temperatures. Over 800 generations of it have been bred with the object of transforming into something that is not a Drosophila melanogaster. It would take 20,000 years to get as many generations of human beings. Every device has been applied to this fly to make it vary its breeding. In 1927 it was discovered that by exposing it to X-rays the rate at which mutations, or marked variations, occurred could be increased by 15,000 per cent.

These breeding experiments are stated to have resulted in the production of some 400 varieties of this fly, some of them monstrosities, and some differing more from the parent form than the other wild species of Drosophila differ from one another. Nevertheless, all these varieties (unless they are too imperfect to breed at all) are stated to breed freely with the parent stock, whereas the different wild species of Drosophila on the rare occasions when they can be induced to cross, either yield no offspring at all or sterile hybrids. Immutability of species, like a mysterious angel with flaming sword, stands barring the way to the evolutionist Garden of Eden.

Summed up, the position is that there is no evidence of any interbreeding community of living things being able to change its breeding and become transformed into some different kind of thing infertile with the original stock. Evolution asserts that all species came into being in this way. And evolution is wholly unable to provide any vestige of proof of its assertion. Belief in evolution today must thus rest on "general considerations," just as Darwin privately confessed was the case awav back in 1863. In our next three chapters we

shall discover how these general considerations—the cloud capp'd towers and gorgeous palaces of evolution—melt away like the baseless fabric of a vision when peered at too curiously.

Chapter III

EVOLUTION'S CASE TODAY

THE first thing noticeable about modern presentations of the case for evolution is the widely different ideas held by various evolutionists as to what constitutes proof of a proposition. If we make our starting point the article on evolution in the current (1929) edition of Britain's standard reference book the Encyclopaedia Britan-nica, we read that evolution is supported by "overwhelming" evidence. If we turn to certain of the recent presidential addresses to the biological sections of the British Association, we shall find scientists there affirming on exactly the same evidence that evolution is not a proved fact but purely a matter of faith.

We live in an age of propaganda circulated throughout the world from obscure sources for obscure ends. Perusal of some articles in the successive post-war editions of the Encyclopaedia Britannica shows in various cases a haphazard reversal of view between one edition and the next, and in particular a change from a factual to a propagandist view of evolution in the three brief years between the thirteenth edition of this work of reference in 1926 and the fourteenth in 1929.

In the 1929 edition two eminent biologists combine to write the general article on evolution. There is a brief, very positive and very dogmatic introduction by the biological editor of the edition, Professor Julian Huxley, then professor of physiology at the Royal Institution; but when it comes down to cold hard facts a great part of the positive-ness fades away in the main part of the article written by Professor E. S. Goodrich, professor of zoology and comparative anatomy at Oxford University.

Both these ardent evolutionists make weak starts. The first item is an announcement by Professor Huxley that "among competent biologists and geologists there is not a single one who is not convinced that evolution has occurred and is occurring," and Professor Goodrich on taking up the running immediately asserts that "it is now universally held by all competent biologists" that evolution is a fact.

These statements are weak for two reasons. In the first place they suffer from the defect of being untrue. There are some fully competent biologists and geologists who have publicly rejected the entire

theory of evolution as baseless. A list of them will be found on pp. 102-105. In the second place, the statements are weak because the truth of a scientific proposition is not to be established by counting noses. Professor Julian Huxley's own eminent grandfather expressed himself very freely on this, matter of nose-counting. "Government by average opinion," he wrote," is merely a circuitous method of going to the devil. Those who profess to lead but in fact slavishly follow this average opinion, are simply the fastest runners and loudest speakers in the herd which is rushing blindly to its destruction" (Huxley's Life, ii, 125).

When theologians state that most people believe in the existence of God Almighty, evolutionsts like Professor Julian Huxley tell us this is merely evidence of the prevalence of superstition and credulity. On the other hand, credulity in scientific circles apparently turns fancy into fact. Besides being unreliable in their nose-counting, these two eminent encylopaedists are illogical in their deductions from it.

However, it appears that there is secondary support for evolution beyond the mass of scientific noses upholding the theory. Professor Huxley assures us in the encylopaedia that "by now the evidence is overwhelming." The evidence is as follows :—

(1) Fossils, which are stated to provide "complete proof,"

(2) Vestigial organs, that is to say, useless parts remaining from ancestral forms of being;

(3) Embryology, showing the embryo developing through ancestral forms of the species.

In addition, the general plan of plants and animals is said to bear witness to a common descent. Their geographical distribution is described as easy to explain on evolutionist lines, but difficult otherwise. Also, evolution is held to have "pragmatic value" in explaining things.

The foregoing are simply the "general considerations" which Darwin, as we have seen, referred to in 1863 in privately admitting the absence of any rag of proof that any living thing could change into any other kind of living thing infertile with the parent stock. Professor Julian Huxley passes over this total absence of real proof of evolution without notice.

The decline of the Encyclopaedia Britannica from a factual to a propagandist work of reference is evidenced by referring to the article on embryology appearing in the thirteenth edition three short years before Professor Julian Huxley was holding forth in the 1929 edition. This thirteenth edition article was written by Professor Adam Sedgwick, professor of zoology at the Imperial College of Science and Technology. Professor Sedgwick dismisses as baseless the idea that fossils, embryology, and vestigial organs provide any "proof" at all of evolution. In discussing the Darwinian theory as elaborated by

Haeckel that the embryo in developing recapitulates the ancestral history of the species, Professor Sedgwick says of this class of "evidence":

"When we come to look for the facts upon which it is based, we find that they are non-existent, for the ancestors of all living animals are dead, and we have no means of knowing what they were like. It is true there are fossil remains of animals which have lived, but these are so imperfect as to be practically useless for present requirements. Moreover, if they were perfectly preserved, there would be no evidence to show that they are the ancestors of animals now living. They might have been animals which have become extinct and left no descendants.

"Thus the explanation ordinarily given of the embryonic structures referred to is purely a deduction from the evolution theory. Indeed, it is even less than this, for all that can be said is something of this kind : if the evolution theory is true, then it is conceivable. (Note : not 'it is certain,' or even 'it is probable') that the reason why the embryo of a bird passes through a stage in which its pharynx bears some resemblance to that of a fish is that a remote ancestor of the bird possessed a pharynx with lateral apertures, such as are at present found in fishes." Professor Sedgwick remarks incidentally that although fishes have teeth, no teeth are to be found in bird embryos.

In Professor Sedgwick's view what Professor Julian Huxley calls "overwhelming" evidence is no evidence at all. The evolutionist can find a succession of fossil remains of different types of animals in different geological strata : but that present animals are the descendants of extinct ones is pure assumption. The whole evolutionist case is made up of one assumption placed on top of another assumption. All is guesswork from start to finish.

Before going on to the main evolutionist line of "complete proof" in the fossils, the minor counts are worth looking over. With respect to the common plan of plants and animals, this amounts to little. All plants and animals have to live in a common environment of land, air, and water, and a common plan is just as much to be expected on Creationist as on Evolutionist belief. As to geographical distribution, Darwin wrote to Hooker that to get his species about the world, he was always ready to raise up "former immense tracts of land in oceans if any case required it in eminent degree," adding : "... at present I much prefer land in Antarctic regions . . . you have thus to invent much less land, and that more central ..." {More Letters, i, 115). If Darwin could do this, the Almighty should be able to manage it also. As to evolution's pragmatic value in explaining things, one finds an evolutionist author, Mr. A. Beebe, quoted as writing quite seriously in his book The Bird : "The idea of miraculous change which is supposed to be an exclusive prerogative of fairy tales is a common phenomenon of evolution." Does "pragmatic value"

simply mean that in scientific circles an untrue explanation is considered better than no explanation ?

Professor Goodrich, in coming down to the details in the fourteenth edition of the encyclopaedia, speedily loses the easy positive touch of Professor Huxley in opening the evolution article. Professor Goodrich begins by dispensing with the services of the Almighty altogether in his evolutionist Garden of Eden. Everything came from protoplasm, and "there must have been a time" when protoplasm first appeared. It "must be supposed" that inorganic substances started forming compounds, and that some of these kept on reforming themselves, and "once they started on this trick" they "would inevitably tend" to perpetuate themselves. These things "probably occurred" in the sea.

The actual fact of the matter is that neither Professor E. S. Goodrich, F.R.S., nor any other scientist, can produce for examination any inorganic substances which keep on forming compounds indefinitely and turning into living organisms. All the many attempts of scientists to produce living matter from non-living matter has been a dead flat failure. What Professor Goodrich talks of is no more producible than are Hans Andersen's witch with the tinder-box and dog with eyes as big as mill-wheels. The main difference is that Hans Andersen's flights of fancy are easier reading than professorial jargon.

Vestigial organs in animals and plants are stated by Professor Goodrich to be "numberless." The human vermiform appendix and the splint bones in horses' legs are two much-quoted vestigial organs. However, the professor proceeds in the encylopaedia with the following remarkable statements about such organs : "Unless they have been adapted to fulfil some new function, they are apt to diminish and disappear ... It is doubtful whether any useless parts are ever preserved for long unless they are insignificant, and many of the so-called vestigial organs are now known to fulfil important functions."

According to Darwin, evolution is proved (or nearly so) by the presence of organs "bearing the plain stamp of inutility" and "imperfect and useless." On the theory of creation, he argued, the presence of useless organs was inexplicable. On the theory of evolution, they were explainable as atrophied survivals from past forms of being. When Professor Goodrich talks of many vestigial organs fulfilling useful functions he at once knocks completely to pieces any claims such organs have as evidence of evolution. Grant them any use and they wholly cease to be vestigial organs in the Darwinian sense of useless survivals. The modern evolutionist tries to eat his cake and have it.

Mr. Douglas Dewar, F.Z.S., an anti-evolutionist, discusses these vestigial organs at length in his Difficulties of the Evolution Theory and More Difficulties of the Evolution Theory. He points out that the

number of supposedly useless organs decreases as biological knowledge increases, and he suggests that those which remain may represent no more than the measure of our ignorance. If biologists had not been so busy hunting for useless organs to prove evolution, the use of many might have been discovered already.

Evolutionists describe the splint bones in horses as vestigial remains of extra toes. Mr. Dewar in his More Difficulties (p. 54) quotes Hayes, an authority on the horse, as stating that these bones (1) strengthen the leg, (2) serve as an attachment for certain muscles, and (3) in conjunction with the canon bone form a groove in which lies the upper part of the suspensory ligament supporting the fetlock and counteracting the effects of weight. How much is left of their vestigial uselessness?

Since King Edward VII had his coronation postponed for a year in order to have his vermiform appendix removed, vast numbers of lesser persons have discovered that they can part with this portion of their anatomy without immediately fatal results. Mr. Dewar, in his Man, a Special Creation, notes Dr. Le Gros Clark, professor of anatomy at St. Thomas's Hospital, London, saying in 1934 in his book Early Forerunners of Man (p. 205) : "The significance of the vermiform appendix is still quite obscure, but in view of its rich blood supply it is almost certainly correct to regard it as a specialised and not a degenerate organ."

Mr. Dewar remarks that while Darwin wrote in a general way about nascent organs, no evolutionist has been able to point in either extinct or existing forms of life to any nascent organ in course of development; yet if evolution is a fact all organs must have had rudimentary beginnings. The complete absence of nascent organs is usually passed over in silence in evolutionist literature. Enough hurdles have to be jumped without looking for more.

Embryology is affirmed by Professor Goodrich in the encyclopaedia to afford "strong evidence" of evolution; but he admits that Haeckel's law of recapitulation is "a gross exaggeration." In the 1929 encyclopaedia article on embryology by Professor D. M. S. Watson, professor of zoology at London University, we learn that research to confirm Haeckel "can scarcely be said to have succeeded in its original aim."

In 1938 there was published at Oxford a book of essays entitled Evolution, and written by colleagues and former students of Professor Goodrich in commemoration of his seventieth birthday. The editor was Mr. G. R. De Beer, senior demonstrator in zoology and lecturer in embryology at Oxford. Here is all that Mr. De Beer will allow for embryology as "proof" of evolution :

"... Very soon, in their enthusiasm for the great new revelation

(evolution), biological students were making embryological facts subservient to their evolutionary theories. . . Thus arose the famous theory of recapitulation ... as is so often the case with half-truths, this theory enjoyed wide acceptance . . . Nevertheless, it must be realised that the theory contained a fallacy which for two reasons impeded the progress of biological work and thought ... In many cases it can be proved that the developmental history cannot represent the phylogenetic (species) history" (pp. 57-58).

This is open admission by an ardent evolutionist of one of the chief counts brought by anti-evolutionists. They complain, and on good grounds, that the theory of evolution has led to continuous and wholesale distortion of observed fact in order to make it fit in with evolutionist preconceptions. To such an extent has this proceeded that in modern scientific literature, especially the popular variety, it is impossible to distinguish between what has been observed and what is speculative embellishment. Fact and fairy-tale are muddled up indiscriminately.

According to Mr. De Beer, the most that can be said for embryo-logical evidence of evolution is that "the structure of the adult ancestral form may sometimes be inferred (his italics) from that of the developmental stages of its descendants " (p.61). In other cases "little or no information" may be gleaned. On top of this, as Professor Sedgwick points out, nobody knows what the ancestral forms of any animal were, and what little remains of embryological "proof" of evolution thus subsides into moonshine.

Darwin wrote in the Origin of Species of gill-slits and a tail in the human embryo as evidence of fish and animal ancestry. Mr. Dewar and other evolutionist and anti-evolutionist writers point out that there are no slits at all, but simply depressions. These have nothing to do with breathing arrangements but develop into tissues connected with the ear, lower lip, tongue, cheek, and various other things. As for the embryonic tail, this bends inwards and forms the attachment for various muscles and also gives additional support to man's internal organs necessitated by his upright posture. Mr. Dewar remarks in his More Difficulties (p. 36) that in the human embryo a length of intestine also projects from the body for a period, but so far evolution has not claimed this as evidence of anything. All the indications, he states, are that the embryo wastes no time in meandering about repeating ancestral history, but develops in the most direct and expeditious manner possible in the circumstances.

Enough has been quoted in admissions from evolutionist sources to show that the miscellaneous exhibits in the shop window come down to very little indeed. None of the items provides any proof of anything, and the most that can be said of any is that it provides a basis for speculation. We now turn to the last remaining line of evidence, the fossils.

Chapter IV

FOOTPRINTS ON THE SANDS OF TIME

IT has been said that a man studying the fossilised remains of plants and animals can take away from them any theory he brings with him at the outset. In other words, the fossils themselves are one thing, and the inferences drawn from them are another matter altogether. In dealing with this part of evolution's evidence, it is thus advisable to bear in mind just what the rocks show. To begin with, the geologists divide the succession of strata in which fossils are found into three great ages :

(1) The Palaeozoic Era (Ancient Life), the age of shells, corals, crabs, lobsters, and later the fishes; on land, scorpions and insects appear, and at the end of the period the earliest reptiles. Seaweeds are the earliest plants, followed by mosses and ferns on land, some growing to giant size in the swamp forests of the world's coal-bearing rocks of this era.

(2) The Mesozoic Era (MiddleLife), the age notably of giant reptiles, in which the birds later appear, all this life reproducing by spawn or eggs; the first mammals, producing their young alive, also appear; seed-plants and trees are also found.

(3) The Cainozoic Era (Newer Life), the age of mammals and of flowering plants.

These eras, also known as Primary, Secondary and Tertiary, are sub-divided into fifteen periods, the earliest period of the Palaeozoic era being known as the Cambrian. Each of the three geological ages is separated from the next by a marked physical break, with upheavals or outbreaks of volcanic activity.

The evolutionist contention is that the later forms of life seen in the rocks are the descendants of the earlier forms. The evolutionist infers this. The fossils themselves show no more than the order of succession in which the different types of plants and animals appeared. Transitional forms which must have existed if evolution is a fact, and for which names were allotted in advance after evolution became fashionable—pro-this and pro-that—have failed to appear, although the whole earth has been ransacked for them during the past eighty years.

The anti-evolutionists contend that the fossils do not in the least support the idea of evolution of species from a common stock. Even an evolutionist like Professor Max Westenhofer writes in 1937 in his Research and Progress (iii, 92) : "All the larger groups of animals, e.g., fishes, amphibians, reptiles, mammals seem to have appeared suddenly on the earth, spreading themselves, so to speak, in an explosive manner in their various shapes and forms. Nowhere is one able to observe or prove the transition of one species into another, variation only being possible within the species themselves" (as quoted in Dewar's More Difficulties, p. 94).

Dr. W. Bell Dawson, F.R.C.S., a Laureate of the French Academy of Sciences, and a well-known Canadian geologist, says of the fossils : "This sequence is evidently the same as in Genesis; for in both, the creatures that swarm in the sea come first, and the land animals last. When each type of creature comes into being, it continues to the present day; as, for example, the sea shells, the crabs, and the reptiles; but in each type there is a magnificence in the past from which it has now deteriorated. Many ancient species are identical with forms still living; and many organs of their bodies, such as the claw of the lobster or the multiple eye of the crab, are precisely the same as in the earliest ages without any sign of improvement. Whole categories of facts such as these, seem to be lost sight of by those whose vision is obscured by evolutionary theories; for they run counter to any conception of evolution" (The Bible Confirmed by Science, pp. 73-74).

Another geologist, Joseph Le Conte, says : "The evidence of Geology today is that species seem to come into existence suddenly and in full perfection, remain substantially unchanged during the terms of their existence, and pass away in full perfection Other species take their place, apparently by substitution, not by transmutation" (as quoted by Dawson, op. cit., p. 75).

Evolution's first hurdle in the fossils is the sudden bursting into view in the Cambrian rocks of a highly developed aquatic fauna and flora. Scientists hold that the time required for life to reach the stage there exhibited was greater than for all the subsequent development. Yet they are unable to find evidence of this first half of evolution. In the earlier Pre-Cambrian rocks there is nothing save a few vague markings claimed by their discoverers as fossils, but everyone of which is disputed.

Mr. Dewar, in More Difficulties of the Evolution Theory (p. 114) states that, except for Walcott's supposed Beltina in North America and David and Tillyard's supposed Eurypterid in Australia (both of them kinds of sea-scorpions), the rest of the few alleged pre-Cambrian fossils are either supposed secretions, or marks made by animals or plants, or organisms that fit into no known group of animals or plants.

The president of the American Palaeontological Society said in 1935 that Walcott's find could not be accepted until verified by further discoveries; and Britain's leading scientific journal Nature of December 12, 1936, described the Australian find as "unconvincing." Even if the whole little handful of these disputed Pre-Cambrian fossils is a'ccepted they still throw no light on the evolution of the mass of life abruptly appearing in the Cambrian rocks.

Evolution supposes that fishes turned into reptiles, and reptiles into birds, elephants, and men and so on. The innumerable transitional forms demanded by the theory cannot be found. At one time much was heard of the fossils, Archaeopteryx, a fully feathered bird with teeth, and Archaeornis, as links between bird and reptile, but even the Oxford University Evolution book of 1938 dismisses these as "indubitably birds" (p. 322). In Professor J. B. Pettigrew's Design in Nature (p. 207), Huxley is quoted as rejecting Archaeopteryx as a missing link as far back as 1876.

Mr. B. W. Tucker in this Oxford book devotes an essay to speculating on the kind of creature this "Pro-Avis" missing link may have been. Pycraft, he says, imagined an arboreal parachuting reptile taking flying leaps from tree to tree. Nopsca developed the idea of a two-legged running reptile waving its arms to increase speed. Mr. Tucker himself favoured the notion of an arboreal reptile with legs adapted for springing, a grasshopper kind of creature. Another scientist, Steiner, helped things on with a theory that wings developed by the edges of reptilian scales fraying out to form feathers. This problem in evolutionist "science" seems suitable for reference to the crossword puzzle fraternity. The fact of the matter is that the extinct giant flying reptiles had wings on quite a different plan from bird's wings. And there is no more evidence of how these wings were evolved than there is of the evolution of bird wings.

Putting these imaginings on one side, let us return to the Encyclopaedia Britannica for light on what has been actually observed in the rocks. Professor Julian Huxley in the encyclopaedia's evolution article has given us his word that the fossils provide "complete proof," and the reader is referred to the article on palaeontology to view this proof. There we are told that evolution is evidenced by the Ammonite series of fossils, the Zaphrentis coral series, the Micraster sea-urchin series, and finally the great horse series. None of these series shows one kind of animal changing into another kind. All that is exhibited is minor modification. In the account of the Ammonites the words "it is claimed" appear throughout. Of the Zaphrentis corals, the encyclopaedia says, "It is difficult to select a single case which can be regarded as conclusively established."

The Micraster sea-urchin makes a better effort. Mr. Dewar in his More Difficulties (pp. 195-207) deals with him on the same lines as the

encyclopaedia but more fully. It seems that Dr. Rowe, the great Micraster authority, sorted out 2,000 of these fossils according to geological age and traced out a continuing change in eighteen different characteristics. The Micraster changed his mouth in the course of ages from a circular to a crescent shape, he grew a lip, altered the lay-out of his spines, and so on. Yet when all was done he was just as much a Micraster sea-urchin as when he began. And there was nothing to show that the last Micraster of the series was any more than a variety fertile with the first. As nobody disputes the occurrence of variations, there is little here to help evolution.

However, the famed horse series of fossils is evolution's chief exhibit. The horse, according to the evolutionists, starts off about the size of a dog, and with five toes on his hind feet and four toes on his forefeet. Ke then decides that he has overdone evolution and starts shedding surplus toes until he finishes up with one per foot all round. Multi-toed horse fossils are found both in Europe and America. Some evolutionist horse pedigrees contain solely American fossils, some mix American and European fossils, and a less complete series can be made of European fossils only. Mr. Dewar prints in his More Difficulties (p. 144) two pedigrees by well-known palaeontologists, one with seven intermediate forms between Eohippus and the modern horse, and the other with five. The pedigrees have only two of these intermediate forms in common, and the rest of the ancestry is different.

This horse series, like the sea-urchin series, begins with a horse and ends with a horse. It does not exhibit any other kind of animal turning into a horse. There is nothing written on the fossils to say that the one-toed horse is descended from the many-toed horse. He may be, or he may not. According to the evolutionsts, the one-toed horse appeared later. The anti-evolutionists say these statements are not above suspicion. They quote instances of rocks being arbitrarily re-dated to a later age because one-toed horses have shown up in the fossils in these rocks. Major Wren's Evolution—Fact or Fiction ? (p. 86) says it is recorded as a well-authenticated fact that Mr. John T. Reid, a mining engineer, found fossil remains of a one-toed horse in a cretaceous formation in a coal-mine in Utah. If this is correct it makes the modern horse very much older than his supposed ancestors.

Mr. Dewar in his More Difficulties (pp. 139-148) thinks it possible that the one-toed horse may have been in existence all through. The present writer has no competence to express any opinion on the matter. All he can say is that there are so many admissions by evolutionists of faked or doctored evidence in different directions that a little more is neither here nor there. Everything is supposition. Evolution is supposed to be survival of the fittest, and the writer in turning over an old file of Nature noted Major Leonard Darwin saying in an address at the opening of Down House as a memorial to his famous

father, that no one had been able to fathom what benefit the horse was supposed to have derived by shedding toes.

Two opinions by well-known scientists on the vexed horse question may be of interest. Deperet, the French palaeontologist, says in his Transformations of the Animal World (p. 105) : "The supposed pedigree of the horse is a deceitful delusion, which ... in no way enlightens us as to the palaeontological origin of the horse." Professor J. Bell Pettigrew, F.R.S., professor of anatomy at St. Andrews, said in his Design in Nature (1908, vol. i, p. 217) : "By no means a strong case has been made out for the descent of the horse from a five-toed extinct mammal. Perhaps even less can be said when the teeth of the horse and its supposed ancestor form the fulcra of the argument." It seems unnecessary to say more on the most-paraded item of evolutionist evidence from the fossils.

Of the other vertebrate fossils, the encyclopaedia says : "The equally complete stories of the camel, dogs, and titanotheres have not yet been published and cannot be intelligibly summarised." It is added that "the rhinoceros series is very complex." It is a reasonable inference that if these fossils provided any great evidence in support of evolution it would long ago have been placed on view.

The foregoing constitute the main items in the "complete proof" which evolutionists claim is to be found in the rocks. The anti-evolutionists do not appear irrational when they confess themselves unable to find any grounds therein for believing that fishes have turned into elephants. Mr. Dewar, in his More Difficulties remarks after sixty pages of detailed examination of the various evolutionary fossil series, that even if the claims are accepted at face value, the argument amounts to no more than inferring that a man can run 100,000,000 yards in 11,000,000 seconds because he has been timed to run 100 yards in 11 seconds.

Modern scientific literature enlarges on everything which can be made to support evolution, and passes over in silence all that lends no support to the theory. The public thus seldom has its attention directed to the fact that the earliest of all known plants show little signs of evolution. Yet the following statement made many years ago by Sir J. W. Dawson, F.R.S., F.G.S., in his Geological History of Plants still holds good : "The old Cambrian and Silurian seas were tenanted with seaweeds not very dissimilar from those of the present time." Present-day evolutionist chronology dates the Cambrian period to about 600,000,000 years ago, and the Silurian to about 400,000,000 years, and Homo sapiens to no more than 25,000 to 40,000 years back. The sea-weeds have had longer time than any other plants in which to transform themselves, and there is no transformation. Why ?

The most numerous by far of all animal things, and, according to evolutionists, older by far than reptiles, birds, and mammals, are the insects. Some entomologists estimate that of all animal

species insect species account for 80 per cent. The lowest estimates show insect species as considerably over half the total of animal species. In total numbers of individuals, insects must be at least four-fifths of the world's animal population. Pick up the average evolutionist book, and you will find very little about this immense principality of the animal kingdom. What have the fossils to reveal of insects? In the Smithsonian Report for 1931 Mr. R. E. Snod-grass, of the Bureau of Entomology of the United States Department of Agriculture, writes (p. 443) : "The oldest known insects of the geological records are so much like modern insects that palaeontology gives little assistance in a study of insect structures. Probably no other group of animals have so effectively covered their evolutionary tracks as have the insects." According to the current timetable, insects first appeared about 350,000,000 years ago, and among the earliest were the silverfishes and cockroaches we have with us virtually unchanged today. Where is the evolution ?

The all-pervasive influence of evolutionist dogma is noticeable in Mr. Snodgrass's statement quoted above. In remarking that palaeontology provides little of no evidence of insect evolution, lip-service is at the same time paid to evolution theory : the insects are said to have "covered their evolutionary tracks." That of which there is no evidence is implicitly assumed. From Mr. Dewar's More Difficulties (p. 172) one gathers that scientists endeavour to give an illusion of evolution among insects by assigning different species names to identical insects when appearing in different geological formations.

Darwin and his disciples have never been short of theories to account for the lack of fossil evidence of evolution. Darwin in his Origin of Species after significantly heading his first chapter on the subject "The Imperfection of the Geological Record," went on to say that the succession of forms in the rocks was consistent with evolution, and that it would be very wrong to "falsely infer" because the supposed intermediate forms were not there, that they had not existed. "Negative evidence," he affirmed " is worthless." In his introduction Darwin had said there was no scientific advantage in evolutionist belief over creationist belief unless evolution could be established as fact. When he comes to fossils he says what cannot be found must be imagined to have existed.

To account for the total lack of fossils in the Pre-Cambrian rocks Darwin offered the reader a choice of two theories. One was that the continents and oceans had since changed places, and that the missing fossils are now under the sea. This cannot be either proved or disproved until someone finds a way of draining off the oceans and having a look. Alternatively, Darwin suggested that the weight of the later strata might have squashed the supposed Pre-Cambrian fossils out of existence. Mr. Dewar in his More Difficulties points out that some

Pre-Cambrian rocks still bear impressions of rain drops and of ripple-marks where water had run over them in the days when they were loose sand. If such things remain, it is odd that all the multitude of supposed fossils should have vanished. Mr. Dewar catalogues five main theories and various sub-theories advanced by later evolutionists to account for the absence of Pre-Cambrian fossils. If one theory is accepted all the rest must be rejected.

Darwin had another theory ready to account for the absence of the intermediate forms between species. He argues that the fossil-iferous beds were deposited during periods in which the land was subsiding, and that in between times were long stationary ages when no fossilisation of animal and plant remains took place. In these stationary periods all the evolutionary transformations of species occurred. Evolution is thus a highly private affair, with everything done off-stage altogether from protoplasm to the Cambrian fossils, and with retirement to the dressing rooms for every subsequent transformation.

The stock cry of evolutionists from Darwin's day to the present time has been "the imperfection of the geological record." It is next door to a miracle, they assert, for any living organism at all ever to become fossilised. Well, it so happens that Mr. Dewar, whose valuable work has been so freely quoted herein, and Mr. G. A. Levett-Yeats, both Fellows of the Zoological Society, went to some trouble to compile statistics about fossilisation. Their figures showed that fossilisation was by no means so miraculous as had been supposed.

Taking existing genera of land mammals (that is, all mammals except bats and aquatic ones) these zoologists found that in Europe, where fossil-hunting had been most intense, these mammals had 100 per cent, representation in fossils. North America came next with 90.14 per cent., followed by South America, 72.09 per cent.; Asia, 70.15 per cent.; Africa, 49.65 per cent.; and Australia, 45.83 per cent. The figures thus indicate that if you look hard enough and long enough you have good prospects of finding fossil remains of all existing land mammals. Mr. Dewar holds that "theoretical considerations indicate that the chances are great that some specimens of every genus having hard parts will become fossilised during the period of the existence of that genus."

The interesting and significant part of the story is that a paper embodying the results of these investigations was offered by Messrs. Dewar and Levett-Yeats to the Zoological Society of London, of which they were both fellows. The paper (subsequently accepted by the Victoria Institute, vol. lxiv, 1932), was rejected on the grounds that its results led to no useful conclusions. The result was certainly not "useful" in helping on evolution's argument that what cannot be found must be imagined to have existed. Mr. Dewar further records that on the leading scientific journal Nature in 1937 publishing an as-

sertion by a correspondent that fossilisation was "almost a miracle," he wrote a short letter giving statistics, and this letter Nature refused to publish. Such are the methods by which belief in evolution is maintained and propagated in scientific circles in this dark age of ours. The above facts appear in Mr. Dewar's More Difficulties, chapter xvi.

The theory, of evolution postulates some enormous transformations in animals. It further requires that every stage in these transformations, shall be beneficial to the animal. There is no question of closing down during reconstruction, or even of putting up with present discomfort for future gain. Darwin laid it down in a letter in 1859 that every stage in the change must in itself be of advantage. The eminent Professor Goodrich is similarly quoted in the Oxford Evolution book of 1938 (p. 274), and he adds, "it is often difficult to picture the intermediate conditions."

Mr. Dewar goes slightly further than Professor Goodrich. He says it is not "difficult" but "impossible" to imagine some of the required transformations. In his Challenge to Evolutionists (pp. 52-57) he defies anyone to picture the conversion, for example, of a land mammal into a whale—which conversion all evolutionists assert took place. Each stage, remember, must make the animal fitter for existence than it was before. The land mammal, says Mr. Dewar, must first be converted into a seal-like creature; it must give up using its hind legs and drag them about behind it until hind legs and tail eventually grow together. Its pelvis must shrink in size, and the portion of the body behind the pelvis must somehow twist round on the front part so that the sides come uppermost and undermost, and the lateral motion of the seal-like stage is converted into the vertical motion of the whale stage.

The whale, moreover, gives birth to its young in the sea and suckles it under water. The mother has to develop muscles enabling her to force milk into the mouth of the young one. She has also to develop a cap round her nipple into which the snout of the young one fits tightly. The young one also requires to have its windpipe prolonged above its gullet to prevent the milk ejected by the mother from entering its lungs. All these modifications have to be effected before the young ones are born in the water. There can be no intermediate stages, Mr. Dewar points out, between being suckled in the air and suckled under water. Either sudden miraculous change must be imagined, or equally miraculous prophetic evolution with everything fixed up in advance of the event.

Such are the magical requirements of some evolutionist transformations, of the occurrence of which transformations neither the fossils nor anything else yields the slightest evidence. The imagination is required to take leap after leap. It now remains to view the summit of this monument of human credulity, the amazing collection of balderdash asserted to establish mankind's descent from the beasts of the field.

Chapter V

THE MONKEY-MAN FABLE

DARWIN discreetly waited twelve years after 1859 before applying his evolutionary speculations to human ancestry. His first lieutenant, Huxley, wasted no time in beating about the bush. In his scientific addresses, writings, and lectures to working men and others, Huxley forthwith preached the kinship of man and ape. A large section of the public today believes man's descent to be a scientifically established fact. Actually, this portion of the evolution theory has not so much as a feather to fly with.

Some years ago a London jury awarded a certain peer of the realm £30,000 in damages against the proprietor of a newspaper which had wrongfully described him as of Jewish descent. It would be an excellent thing if those of us who resent the evolutionist libel that our ancestors were apes or other animals were to club together and bring into court all the publishing-houses, professors, etc., pro-claiming it. Nothing more would ever be heard of evolution if evolutionists were forced to come to light with evidence that a judge and jury would accept. If they failed to prove their words damages on a much higher scale than in the case quoted could very justly be claimed, for the moral harm done by evolutionist lying is immense, and this particular lie is a vile one.

The evidence in the monkey-man case rests on certain fossilised remains. The first of these to appear, consisting of a skull-cap and some fragments, was found in a cave near Dusseldorf shortly before the Origin of Species was published. Numerous other skulls of similar type have since been discovered, and are known as Neanderthal man. The earlier skulls were too incomplete to show the position of the aperture by which the spinal cord entered the brain. It was thus impossible to tell whether Neanderthal man stood upright or not. In conformity with their evolutionist imaginings, scientists for a long time assumed that Neanderthal man was a shaggy, crouching, apelike creature. A reconstruction of him on these lines was made by the eminent Professor Boule, director of the Museum of Natural History in Paris. Similar models appeared in other museums, and pictures were freely published. A few scientists protested, but they were ig-nored. In 1929 some more complete remains were discovered at Rome,

and showed Neanderthal man to have had an erect human posture and the evolutionist assumptions to have been unfounded (Dewar, Man, p. 38). Dr. H. H. Woollard, F.R.S., professor of anatomy in the University of London, in Science Progress for July, 1938, describes Neanderthal man as a primitive being, below but nearer to the Australian black than the Australian black is to the modern European.

Rhodesian fossil man is now ranked as of Neanderthal type, and Professor Wood Jones in his Man's Place among the Mammals has pointed out how lack of "a little elementary anatomical knowledge" (coupled no doubt with evolutionist dreamings) similarly caused Mr. W. P. Pycraft in a British Museum report in 1928 unwarrantably to turn Rhodesian man into another crouching ape-like being (quoted by Dewar. Man, p. 38).

Today the three chief alleged fossil "missing links" between man and ape are Java man, Piltdown man discovered in England, and Peking man. Apart from these is Heidelberg man represented by nothing but a massive fossil jaw-bone described by most anthropologists as essentially human but with some simian characteristics. It may be noted that Whitaker's Almanack for 1931 recorded that the remains of Deeming, a notorious Australian murderer of 1892, had been exhumed and were reported by Sir Colin Mackenzie, director of the Australian Institute of Anthropology, to have remarkable simian characteristics. Heidelberg man may thus have had as much or as little connection with the apes as Deeming had.

Java man, otherwise Pithecanthropus erectus, or Trinil man, was discovered by Dr. Eugene Dubois. In 1887 Dr. Dubois, then holding a junior position on the staff of Amsterdam University, surprised his colleagues by refusing promotion, and announcing his intention of going out to Java as a Dutch army doctor in order to hunt for evolution's missing link between man and monkey (vide Prof. Elliot Smith in Smithsonian Report, 1931). In 1894 Dr. Dubois duly returned with his alleged monkey-man and became the lion of the scientific world.

These fossil remains, which have ever since been the subject of controversy, consist of a skull-cap of chimpanzee type, with no forehead and beetling brows; two molar teeth; and a diseased thigh-bone of human type and abut the size of that of a man 5ft. 7in. high. They were discovered by Dr. Dubois near Trinil in central Java, in a part of the bed of the Bangawan River only uncovered in the driest part of the dry season.

The point at issue is whether any ground exists for assuming these remains to have belonged to one and the same individual. The owner of the skull-cap obviously had a head very like that of a chimpanzee, but of exceptional size, for the largest existing ape has a cranial capacity of about 625 c.c., and the scientists figure it out that

the Java skull-top indicates a cranial capacity of about 900 c.c. Here it may be noted that an Australian aboriginal had a 1,250 c.c. brain-case, and a modern European averages around 1,400 c.c.

Whoever owned the Java thigh-bone very obviously stood upright, which no ape does. As for the two teeth, they are generally described as ape-like but unusual. Combine the fragments, and the result is a creature standing erect, with chimpanzee brows and no forehead, a human thigh, and with face, feet, body and arms left to be sketched in according to fancy.

Dr. Dubois' great discovery began with the finding of a tooth in the riverbed in September, 1891. A month later he discovered the skull-cap a yard away. Continuing his explorations of the same locality in September, 1892, he found the thigh-bone 50 feet away from where the skull-cap had been; and also the second tooth, 13 feet away from the thigh-bone and in the direction of the skull-cap. The skull-cap was water-worn and eroded. The teeth and the thigh-bone had their contours clear and sharp, and apparently had not moved since their original deposit.

Dr. Dubois attributed the erosion of the skull-cap to seepage from a cliff on the river-bank. In the report of the Smithsonian Institution of the U.S.A. for 1898 appears the text of an address delivered by Dr. Dubois to the Berlin Anthropological Society in 1896; and in the Smithsonian Report for 1913 is a very full paper on all the remains of fossilised man known to that date, compiled by Dr. A. Hrdlicka, curator of the Division of Anthropology of the U.S. National Museum, after a special mission to Europe to examine them for the Smithsonian Institution. From the plans, illustrations, and letterpress in these reports, it appears that the eroded Java skull-cap was up-stream from the uneroded teeth and thigh-bone. But no doubt water would run uphill to help on evolution.

In his Berlin address on his discoveries, Dr. Dubois stated that "associated with these bones" he had found fossil remains of Steg-odon (an extinct elephant) and of a small deer, and "further away" remains of buffalo, antelope, ox, pig, rhinoceros, and hyaena. Sir Arthur Keith in his Antiquity of Man says that altogether Dr. Dubois removed from this spot in the bed of the Bangawan River between 1891 and 1894 fossils of twenty-seven different kinds of mammals. A German expedition under Madame Selenka also spent two years from 1906 making much more extensive explorations in the same spot and unearthed an immense quantity of miscellaneous fossils, but got no traces of monkey-men.

It thus appears that the scanty fragments constituting Java man were sorted out by their discoverer from a pretty complete Noah's Ark bone-heap. This discoverer, moreover, is stated to have sacrificed

a superior position in Amsterdam for an inferior position in Java for the express purpose of hunting for the monkey-man missing link predicted by evolution. Most of us in such case would be prone to view in the most hopeful light whatever oddments our digging in tropical riverbeds might produce. We would have our monkey-man or perish in the attempt.

Dr. Dubois told the Berlin savants in 1896 that "in other situations of the same stratum" he had found fossil remains of a gigantic scaly ant-eater and of hippopotamus. He did not tell them that in these "other situations" there had been discovered in 1889 at Wadjak about fifty miles from Trinil, a fossil human skull of Australian black type, and that he himself in 1890 had there unearthed a second fossil skull of the same type. These interesting facts Dr. Dubois strangely withheld from publication until 1920, fully thirty years on. According to Nature for January 6, 1921, he then casually disclosed them following on discussion of a find of fossil man at Talgai, Queensland. Possibly Dr. Dubois had good reasons for keeping quiet for so long. At the same time it requires no great powers of penetration to perceive that the cause of evolution might not have been helped by revealing true man as in existence along with his supposed monkey-man ancestor. As Sir Arthur Keith remarks, to have put all the articles on the table simultaneously would have provided the learned with more than they could digest—perhaps with more even than they could swallow.

Java man—still evolution's chief mainstay—appears throughout his career to have been shrouded from the gaze of profane eyes. One finds Dr. Hrdlicka writing thus in the Report of the Smithsonian Institution for 1913 : "All that has thus far been furnished to the scientific world is a cast of the skull-cap, the commercial replicas of which yield different measurements from those reported taken of the original, and several not thoroughly satisfactory illustrations: no reproductions can be had of the femur and the teeth, and not only the study, but even a view of the originals, which are still in the possession of their discoverer, are denied to scientific men." Dr. Hrdlicka, official emissary of the great Smithsonian Institution, presided over by the President and Chief Justice of the United States, was refused permission even to inspect the originals. He described the position as "anomalous."

Since 1936 two incomplete skulls and some skull fragments, similar to the Java man skull-cap, have been discovered at Sangiran in Java by Dr. G. H. R. von Koenigswald, as recorded in Nature of December 2, 1939. The most complete of these gives a cranial capacity of 835 c.c, according to its discoverer, as against the 900 c.c. estimated for the Dubois Java man. No human-like thigh-bones or other skeletal parts had been discovered up to the last report seen by the present writer.

There has never been the least agreement among scientific men that Dr. Dubois was justified in assuming his skull-cap and thighbone to belong to the same individual. In his Berlin paper of 1896 Dr. Dubois tabulated the opinions of about a score of leading scientific men on the remains, showing the utmost variance. Finally, to cap all, Dr. Dubois himself in 1938 announced that after prolonged study of anthropological textbooks, of the Pithecanthropus bones, and "of other material from the same provenance in his possession, for the most part not previously published," he was of opinion that "we are here concerned with a gigantic gibbon."

In making this announcement in its issue of February 26, 1938, Nature flatly refused to yield up Java man as evolution's prize exhibit. Dr. Dubois' new conclusions about his fossils, it said, had been received "with respect, but not with general acceptance; and in the light of the new evidence must be regarded as definitely disproved." This leading scientific journal then asserted : "Pithecanthropus now stands within the line of human descent, if only as a pre-hominoid."

It thus appears that the editor of Nature is a better authority on Java man than its discoverer. Nethertheless, whatever Pithecanthropus may have been, it is quite impossible for him to have been ancestral to man, as we shall see later. Nature's dogmatic statements, moreover, are extremely rash in view of Dr. Dubois' announcement that even after half a century he still has some cards up his sleeve in unpubli-cised Trinil fossils. Java man would probably never have been heard of, had Dr. Dubois in 1894 placed his two Wadjak human skulls on the table alongside his Trinil chimpanzee skull-cap and human thighbone. Java man is hardly likely to be abandoned by his discoverer without the very best of reasons.

Piltdown man, otherwise Eoanthropus, or Dawn man, is the next item on the monkey-man list. He hails from a fossil-bearing stratum six inches thick, near the bottom of a small gravel pit, four feet deep, used for metalling a by-road on the Sussex Downs, eight miles north of Lewes. Piltdown man consists of nine small fragments of skull-bone, and rather less than half of a chimpanzee-like jaw bone. There was not much of him altogether, and he was discovered in sections over a considerable period of years by Mr. Charles Dawson, solicitor of Lewes, an amateur fossil-hunter. Toward the end the assistance was secured of Dr. (later Sir) A. Smith Woodward, of the British Museum staff and soon afterwards president of the Geological Society.

This jig-saw puzzle was laboriously fitted together—so far as it would fit—to form part of the top and back of a skull. The vacant spaces were filled with plaster of pans, with forehead and facial bones duly modelled in plaster. Finally, the jaw-bone, with its missing three-fifths also completed in plaster, was neatly hung on in front. The resulting monkey-man was then exhibited to a crowded and

sensational meeting of the Geological Society in London on December 18, 1912.

Piltdown man as first presented was announced to have a cranial capacity of 1,070 c.c, which puts him ahead of Java man's 900 c.c., but well below the Australian blacks' 1,250 c.c. He has been several times reconstructed—apparently with still more generous assistance from the plaster-pot—as he is nowadays quoted as measuring 1,300 c.c. in cranial capacity.

The chief of the numerous points at issue in this highly conjectural item of evolutionist evidence is whether the chimpanzee jawbone ever had any real connection with the human skull fragments. It is a debatable point, and there is the utmost diversity of opinion in scientific circles on it. There is reason for doubt, for along with the skull fragments and jaw-bone there were extracted from this six-inch wide fossil-bearing stratum the following things : A tooth of a mastodon, a tooth of a Stegedon (an extinct elephant previously unknown in Western Europe), two teeth of a hippopotamus, two teeth of a beaver, the femur of an elephant shaped up for use as a tool, and finally some flint implements. There would appear to be nothing wildly incredible in a real chimpanzee having contributed part of a jaw-bone to this miscellaneous zoological collection.

Piltdown man got the late Mr. Charles Dawson a monument, and helped Dr. Smith Woodward on to the presidency of the Geological Society in 1914 and a knighthood later on. His claims are by no means universally accepted, for one finds Professor Sir Grafton Elliot Smith stating in 1931 of this evolutionist exhibit: "Even today many Continental anthroplogists refuse even to refer to it in treatises on fossil man, or when they do, brush it aside as so doubtful that it is best to ignore it" (Nature, June 27, 1931).*

Peking man, the final exhibit of the series, next presents himself to our view. He hails from the floor of a cave in a disused limestone quarry, thirty-five miles southwest of Peking in China. In the Smithsonian Report for 1931 Professor Elliot Smith stated that Dr. Davidson Black, on learning of the discovery of a peculiar fossil tooth somewhere near Peking, went out to China to join the Chinese Geological Survey in the hope of finding a fossil monkey-man. In 1929 Dr. Black made his first discovery of an incomplete skull. A considerable number of skulls have since been found, one or more complete enough to show the nose as broad and flat; and the cranial capacity of the skulls is put at from 1,000 c.c. to 1,100 c.c.

These remains so closely resembled the chimpanzee-like Java skull-cap that there was long argument whether Peking man was sufficiently distinct from Java man to be allotted a scientific name of

* In an article in the Times of Nov. 21st 1953 a British Museum correspondent admitted the fraudulency of Piltdown Man. (Editor)

his own. Eventually he was christened Sinanthropus, though some scientists affirmed that there was next to nothing to distinguish him from Pithecanthropus erectus of Java. In Nature of December 2, 1939, it was recorded that seven thigh-bones of Peking man had been discovered, mostly incomplete shafts, and according to the descriptive matter they lacked the human characteristics of the Java thigh-bone. Incidentally, it may be noted that along with Peking man there were also found in the cave floor remains of over fifty types of mammals, as well as fossil frogs, snakes, turtles, and birds. Up to 1930 no less than 1,475 cases of fossil bones were removed from the site (vide Prof. G. B. Barbour at the British Association, Nature, September 27, 1930).

Java man got his semi-human attributes by assumption that a human thigh-bone had belonged to a chimpanzee skull-cap. Peking man is Java man over again, but without any human thigh-bone. In view of the condition of uncritical credulity induced in the scientific mind by the evolution theory, the layman must be pardoned for wondering if the position is that Peking man climbs up to semi-human status on Java man's knees—or Java man's thigh-bone, to be precise. If such is the case, one can understand the total havoc which would be wrought in mankind's evolutionary ancestry were Dr. Dubois permitted to fling Java man to the wolves as a mere ape and nothing more. Not only would evolution's No. 1 exhibit vanish, but down with it would crash Peking man also. The sole remaining monkey-man would then be Piltdown man. And when the plaster of paris is removed how much is left of Piltdown man ? Nothing but a few fragments of bone which look as if they might all be packed up inside a breakfast cup. It may be that the editor of Nature scented this impending tragedy when he so flatly refused to part with Java man on any consideration whatsoever—not for all the Dr. Dubois in the world.

We now come to the final point. No matter just what Java man, Piltdown man, and Peking man may have been, it is quite impossible for them to have been ancestors of man. The reason is that full-fledged man, Homo sapiens, was already in existence, cooking his breakfast, making his tools, and going about his daily business when evolution's alleged missing links appeared.

Mr. Dewar, F.Z.S., in his More Difficulties of the Evolution Theory (p. 93) points out that fossils of men of modern type have been discovered in deposits "certainly at least as old as, probably older than" those containing Java man, Peking man, etc. He enumerates the Castenedolo, the Olmo, and the Calaveras fossil skulls, the Oldo-way and Clichy skeletons, and the Abbeville, the Foxhall, the Kanam and Kanjera fossil jaws. Mr. Dewar is an anti-evolutionist, and anti-evolutionists are beyond the pale in well-conducted scientific circles. We therefore lay his statements aside.

We turn instead to the leading British scientific quarterly review Science Progress issued by the highly respectable publishing house of John Murray. In the number for July, 1938, we find there an article on "The Antiquity of Recent Man" by Professor H. H. Woollard, F.R.S., professor of anatomy at University College, London. Needless to say, Professor Woollard is an evolutionist. No anti-evolutionist would for one moment be permitted to occupy the post he holds. However, Professor Woollard is an unusually candid evolutionist.

In his article he reviews the various fossil men. He thinks "there cannot be absolute certainty" that the two bones, plus two teeth, constituting Java man belonged to the same individual. The thighbone is "indubitably human," and the skull-cap "recalls in many ways the form of the acrobatic gibbon." Java man and Peking man form "one type." The Heidelberg jaw is "essentially human," but "the resemblance to the anthropoid jaw is especially close." The Piltdown skull fragments differ only from a modern skull in being unsually thick, and the jaw "resembles most closely that of a chimpanzee and looks incongruous with the skull." In view of later discoveries of fossil man in England, Professor Woollard rejects the jaw as in no way connected with the skull fragments. This leaves Piltdown man just' a plain human being.

As to the age of the various remains, Professor Woollard puts Java man and Peking man as contemporaries in the Lower Pleistocene; Heidelberg man in the Middle Pleistocene; Piltdown man in the Lower Pleistocene, or even earlier; and Neanderthal man in the Upper Pleistocene. As previously stated, Professor Woollard describes Neanderthal man as a more primitive human being than the Australian black, but nearer to him than he is to the modern European.

Professor Woollard remarks that Java man, Peking man, and Neanderthal man form a series rising in cranial capacity, and are regarded by palaeontologists as forming a sequence in the emergence of man from the lower animals. He adds : "The difficulty in feeling content with this view arises because in sharp contrast with these fossil types others have been discovered which are in no way different from modern man, and which are as old, or even older, than those just described." Professor Woollard remarks that, "obviously people living contemporaneously cannot be ancestors to one another."

"The other aspect of the matter, "he continues, "is illustrated by a series of fossils which have been found in various parts of the world, but curiously with quite uncommon frequency in England. A series of very ancient fossils has been found which attest the fact that the modern Englishman, so far as his anatomy goes, extends backwards into the past to a time when in other countries man was distinguishable with difficulty from the ape."

The English skulls referred to by Professor Woollard are the

Swanscombe skull discovered in 1937; the skull discovered in 1925, in excavating for foundations for Lloyds Bank in Leadenhall Street, London; and a third fossil skull found at Bury St. Edmunds. All these he says, date at least to the Early Pleistocene.

Professor Woollard's own evolutionist view is that "man started abruptly, and that in the ancestral stock there was a period of great instability and change, and by mutations many new types were evolved." In other words, you go to bed one night as a chimpanzee (or whatever animal is preferred), and wake up next morning as full-fledged man, with powers of speech, a taste for music, and a faculty for mathematics. Science will swallow anything to dodge away from the idea of God Almighty having had anything to do with man's appearance upon the earth. Needless to say, Professor Woollard adduces no evidence in support of a sudden magical transformation of animals into men.

The degraded condition of much present-day biological science is pretty evident from some of Professor Woollard's candid statements. Consider, for example, the implications of the following :

"If two fossil men are found on the same geological level, and one has a large brain and the other a small brain, invariably it will be shown on a genealogical map that the man with the small brain emerged much earlier from the common stock than one with the big brain. This, of course, is an anatomical inference drawn so because of preconceptions that the evolutionary process must proceed by gradations. It is not founded upon any knowledge got from palaeontolo-gical evidence."

And again : "The discovery that recent man has a vast antiquity, in fact greater than any other variety, most anatomists have always tried to get round or minimise by making all hominoid fossils carry pithecoid features which are absent in present-day man."

These are plain and open admissions by a front-rank evolutionist that evolution is kept going by faked facts and doctored evidence.

We have now gone over the evolutionist "evidence"—if such it can be called—of man's alleged animal descent. Mr. Dewar states no more than plain fact when he says that despite a search extending over the greater part of a century, "it is not possible to point to any fossil and say of it : the species represented by that fossil, while not human, is ancestral to man" (More Difficulties, pp. 93-94).

Having looked over the actual facts in some detail, it is instructive to note the kind of statement to be found in book after book on the shelves of the public libraries in English-speaking countries today. Typical of what is palmed off on an unsuspecting public as established fact, is the following, from Man, the Slave and Master by Dr. Mark Graubard, published by Dent and Sons, London, in 1939, after first appearing in the United States :

"The oldest fossils pertaining to man, almost a true missing link, is the ape-man of Java, with a brain intermediate in size between ape and man, yet walking upright like a man, as his skeletal structure indicated beyond a doubt. There is also the Piltdown or dawn-man with large canines-and small forehead and ape-like jaw. And finally we have the Peking man, definitely outside the genus homo, but more advanced than the ape. The oldest distinctly human fossil is probably that found near Heidelberg and called the Heidelberg man . . . The ape-man of Java and the Piltdown and Peking men all existed about a million years ago . . . The Heidelberg man roamed the earth about half a million years ago."

A suburban grocer selling under-weight butter or adulterated foodstuff is hauled before the courts and punished if detected, but it is nobody's business that reckless evolutionist rubbish, without a rag of fact to support it, is ground out wholesale on the printing presses to poison the public mind. To their everlasting honour there are a number of scientists who have refused to countenance the monkey-man fabrication.

Here is what Professor Wassmann says in his Modern Biology: "It is nothing short of an outrage upon truth to represent scanty remains, the origin of which is so uncertain as that of Pithecanthropus, as absolute proof of the descent of man from beasts in order to deceive the general public." .

Dr. Clark Wissler, Curator-in-Chief of the Anthropological Section of the American Museum of Natural History, said in the New York American of April 2, 1918 : "Man, like the horse, or the elephant, just happened anyhow . . . Man came out of a blue sky so far as we have been able to delve back."

Professor W. Branca, of Berlin, says in Fossil Man: ' Palaeontology tells us nothing on the subject, it knows of no ancestors of man." Professor J. Reinke, of Kiel University, says in his Monism and its Supporters: "We are merely having dust thrown in our eyes when we read in a widely circulated book the following words : 'That man is immediately descended from apes, and more remotely from a long line of the lower vertebrates, remains established as an indubitable historic fact, fraught with important consequences.' . . . The only statement, consistent with her dignity, that science can make, is to say she knows nothing about the origin of man."*

Mr. Douglas Dewar says in his Man, a Special Creation: "The way in which the public is deluded by complete pictures of man's

*These four statements are quoted from Major E. C. Wren's Evolution: Fact or Fiction? p. 68.

supposed ancestors, based on a jaw or a piece of a skull or even a tooth, is scandalous. The public has no idea that these pictures are pure figments of the imagination."

The extent to which evolutionist imaginings can dominate the scientific mind was illustrated by an incident in the United States in 1922, as quoted in Major Wren's Evolution—Fact or Fiction} A single molar tooth was found in a Pliocene deposit in Nebraska. The great palaeontologist, Professor H. F. Osborn, then president of the American Museum of Natural History, described it as belonging to an early type of monkey-man which he duly christened Hesperopithecus. At this date, Mr. William Jennings Bryan was denouncing evolution, and Professor Osborn made the discovery of Heseropithecus the occasion for the following rebuke to Mr. Bryan: "The earth spoke to Bryan from his own State of Nebraska. The Hesperopithecus tooth is like the still small voice, its sound is by no means easy to hear . . . this little tooth speaks volumes of truth"—of man's animal descent.

In England the eminent anthropologist, Professor Sir Grafton Elliot Smith, induced the Illustrated London News to publish an article on this ancestor of humanity, illustrated by drawings of Hesperopithecus and his spouse—all on the strength of one small tooth. Presently, it was established that the tooth was that of a peccary, a kind of pig, and Hesperopithecus disappeared from view. In its 1929 edition the Encyclopaedia Britannica felt it necessary to make reference to this lost asset of evolution, but it wrapped up the horrid truth as well as it could by disclosing no more than that the tooth was eventually found to belong to "a being of another order"—which was one way of spelling "pig" in twenty letters.

In 1925 the State of Tennessee passed a law forbidding the teaching of evolution in its schools, and Mr. Bryan, just before his death, successfully appeared as chief anti-evolutionist counsel in a test case at Dayton, which was given wide publicity, with universal newspaper ridiculing of him. The case was promoted and financed on the evolutionist side by the American Civil Liberties Union, and it is not inappropriate to note that six years later a United States Congressional Committee on communist propaganda said of this body, "fully ninety per cent of its efforts are on behalf of communists who have come into conflict with the law" (House of Representatives' Report No. 2290, 1931, p. 56). Allusion is made to this Tennessee case in a passage in Mr. R. C. Macfie's Theology of Evolution, published in 1933. He says:

"So long as the question is as open as at present, it is scandalous that children and students should be taught as a proven fact that their ancestors were apes, and should be shown abominable pictures of primitive man as a shaggy ape-like creature with a low forehead, receding chin, bowed back, and bent legs. Such science is a disgrace to

the spirit of science and a crime against humanity, fit only for the yellow press, and the Catholics and Daytonians deserve honour for declining to accept a totally unproven hypothesis."

The gospel of man's animal descent is the crown of the evolution theory, and to it all the rest leads. The evidential standards of modern evolutionist science represent probably the lowest point in intellectual degeneration reached by civilised man in the past two thousand years. All is wildest assumption and limitless credulity, and with no other end in view than to arrive, by hook or by crook, at the most debased view of human origins which the mind of man is capable of conceiving.

Chapter VI

HOW EVOLUTION WAS BORN

A SIGNIFICANT fact about evolution is that the central idea of the Darwinian theory is not based upon anything observed in nature. Darwin states that he opened his first notebook for facts in relation to the origin of the species in July, 1837, at which time he was twenty-eight years old. He had observed affinities between living and extinct species in his work as a naturalist during the voyage of the Beagle. He had also noticed how man had produced varieties of domesticated plants and animals by selection in breeding. These observations had led to belief in evolution. "But," he relates, "how selection could be applied to organisms in a state of nature remained for some time a mystery to me" (Life and Letters, i, 83).

Illumination came in October, 1838. It came by Darwin reading the famous Essay on Population of the Rev. Thomas Malthus, with its gospel of an intense struggle for existence in consequence of living things increasing faster than food supply increased. Darwin's own observation in his work as a professional naturalist had not impressed any such idea on his mind as the outstanding fact in nature. The reader will do well to reflect whether this supposed eternal remorseless struggle for existence is a thing which drives itself into his own consciousness in his wanderings abroad. Does he witness it in his garden, about the countryside, in the wilderness, in the air, in the waters? Is he presented with a view of a world with every cranny bursting to suffocation with life, and with the surplus production dying from starvation or trampled underfoot ? Is this evolutionist idea of "Nature red in tooth and claw," with the mangled remains of the unfit strewn in every direction, something real existing for all mankind to see, or is it a dream—a scientific nightmare ?

Darwin certainly had no idea of this fierce struggle for existence as a factor in evolution until he read Malthus. Having adopted the idea as the foundation of his theory, he spent the next twenty years collecting facts to support it. This work involved correspondence with naturalists and others in all parts of the world. Among Darwin's correspondents was a young naturalist named Alfred Russell Wallace. In June, 1858, Darwin received from Wallace, then on an expedition to the East Indies, a paper which Wallace said he would like to have

read before a scientific society, and he asked Darwin to arrange this. Darwin looked at the paper, and was prostrated with mortification to find that it set forth exactly his own idea of evolution by natural selection, or survival of the fittest in the struggle for existence.

The question thus arises where Alfred Russell Wallace got his idea of the struggle for existence. How close it was to Darwin's may be gathered from the letter which Darwin in his anguish wrote to his friend Sir Charles Lyell, the eminent geologist : "Your words have come true with a vengeance—that I should be forestalled... if Wallace had read my MS. sketch written out in 1842 he could not have made a better short abstract! Even his terms now stand as heads of my chapters. . . So all my originality, whatever it may amount to, will be smashed. . . " (Life and Letters, ii, 116). Darwin had guarded his great idea very closely, for in a letter to Lyell a week later all he seemed able to think of as proof of his priority over Wallace was that his intimate friend Hooker, the botanist, had seen his earlier sketch, and that more recently he had given Professor Asa Gray in America an extremely vague and guarded outline of his ideas. As history records, this matter of priority was adjusted by Lyell and Hooker arranging for the reading of a paper by Darwin along with Wallace's paper at the Linnxan Society on July 1, 1858. Evolution thus saw the light with Britain's leading geologist and leading botanist standing as sponsors with explanatory remarks.

Wallace had arrived at exactly the same idea as Darwin, and he had reached it in exactly the same way. He had not observed an intense struggle for existence as a fact of nature. All that had happened—as Wallace relates in his autobiography and elsewhere—was that he had chanced to read Malthus on Population, and then sat down and dashed off an essay on evolution by survival of the fittest in the struggle for existence. After publication of the Origin of Species it came out that Dr. W. C. Wells had read a paper to the Royal Society in 1813 on evolution by natural selection, and that in 1831 Mr. Patrick Matthew had embodied the idea in the appendix to his book on Naval Timber and Aboriculture. It does not appear where these writers found their inspiration. There would be nothing wildly improbable in it coming from the same source, for Malthus published his book in 1798 and it was soon attracting the widest attention.

We therefore turn to the famous Essay on the Principle of Population as the fountainhead of the mighty river of evolution. At last, surely, we shall find it here related just where in nature the Rev. Thomas Malthus witnessed this remorseless struggle for existence. Again we are doomed to disappointment. Before we finish perusing the first two pages of his first chapter we find Malthus in a footnote referring us to Benjamin Franklin's Miscellany, page 9, as the place to learn about the struggle for existence. The present writer has not had access to this last-named book. He is thus unaware whether Ben-

jamin Franklin saw anything for himself, or whether he in turn derived the idea of living things increasing faster than food supply from yet another book. He notes, however, a statement in Buckle's History of Civilisation (World's Classics edition, ii, 247) that it was Voltaire who first threw out this foundation idea for so many theories. As Franklin was United States envoy and minister in France in Voltaire's day, and according to his biographers was intimate with Voltaire, it may be that he picked up the notion there. Our search for evolution's origins thus leads back once more to the peculiar brand of philosophy on which the French Revolution was incubated.

Malthus opens his famous book by stating that his object is "to investigate the causes which have hitherto impeded the progress of mankind towards happiness," and in particular "the constant tendency in all animated life to increase beyond the nourishment prepared for it." Malthus then adds :

"It is observed by Dr. Franklin that there is no bound to the prolific nature of plants or animals but what is made of their crowding and interfering with each other's means of subsistence. Were the face of the earth, he says, vacant of other plants, it might be gradually sowed and overspread with one kind only, as for instance with fennel; and were it empty of other inhabitants, it might in a few ages be replenished from one nation only, as for instance with Englishmen. This is incontrovertibly true. . ."

An Australian writer, Mr. O. C. Beale, in his National Decay (1910, p. 33) remarked that so far from being incontrovertible truth, the spread of fennel quoted by Malthus was a strange and venturesome untruth. No botanist, he said, would admit the statement as being true for fennel or any other plant. Nor had anybody knowledge that Englishmen could survive through ages all over India or throughout Africa.

Mr. Beale noted, to begin with, that this supposed profound truth of Malthus—in reality the foundation of the most colossal errors of all time—is remarkable for its laxities of expression. "Causes," for instance, cannot impede progress : only impediments impede. Is it so sure that there is a "progress of mankind towards happiness ?" In any case this abstract and intangible phrase is no basis for a proposition of importance. As for "the constant tendency in all animated life to increase beyond the nourishment prepared for it," we may assume that by "prepared" Malthus means "available," as otherwise the preparation would be in default. Mr. Beale remarks that Malthus was asked by someone what he meant by a "tendency" which nowhere had the effect ascribed to it. The question remained unanswered. Where was the evidence that mankind, for instance, had ever pressed upon the planet's limits of production ?

The social philosophy of the Rev. T. Malthus was expressed in its most naked form in a paragraph in his first edition, but which he

discreetly suppressed in later English editions. As translated back by Mr. Beale from the French edition, it reads as follows :

"A man born into a world already occupied, if his family can no longer keep him, or if society cannot utilise his work, has not the least right whatever to claim any share of food, and he is already one too many upon the earth. At the great banquet of Nature there is no cover laid for him. Nature commands him to go and she is not long in putting this order herself into execution."

Malthus, writing at a time when the British Isles had a population of 12 millions as compared with their present 47 millions, urged immediate restriction of population as the way to social betterment. He preached voluntary limitation of families, abolition of outdoor poor relief, and the herding of the poor into workhouses with hard fare and husband and wife separated so as to check breeding. These eminently Christian ideas were adopted in part in the British Poor Law of 1834.

The name of Malthus is most prominently associated with the modern practice of birth restriction. "The infant," said Malthus, "is of comparatively little value to society, as others will undoubtedly supply its place. Its principal value is on account of its being the object of one of the most delightful passions in human nature—parental affection." France was the first country to adopt the Malthusian doctrine of baby restriction, and France has been the first great European nation to go under. In Britain it was preached with immense success by John Stuart Mill, George Jacob Holyoake, Charles Brad-laugh and Annie Besant, and the birthrate of the whole British race has now fallen below the point necessary to maintain population.

From Malthus also was derived in large part the inspiration of David Ricardo's Principles of Political Economy, as Ricardo himself admitted therein. The Ricardian doctrine of every man for himself and devil take the hindmost coloured all nineteenth century economic thought: and, via Ricardo, the Malthusian gospel of the struggle for existence was transformed by Marx into the class war of his revolutionary socialism. Malthus thus helped to provide bloodthirsty Bolshevism with its theoretical outfit.

Finally, through Charles Darwin the same Malthusian teaching became the foundation of the theory of organic evolution, itself in turn the sheet anchor of materialism and atheism; and with a large percentage of its adherents attached also to the birth-control and Bolshevik fruits of the same tree.

Such is the enormous fabrication of error built upon one fantastic untruth. No one has ever seen this imagined, continuous intense struggle for existence with all living things pressing to the limits of food supply, and with mass starvation of surplus population. The whole thing is a dream. All animals have to bestir themselves to get their

breakfast it is true : but that is all there is to it. Even the orthodox evolutionists today are unable to discover Darwin's imagined struggle for existence. "It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms," said Darwin in his Origin of Species. Here is what a modern specialist has to report. The extract is from the Oxford book on Evolution of 1933, to which reference has been made in previous chapters. The writer of the essay quoted is Mr. Charles Elton, director of the bureau of animal populations at Oxford University. He says :

"A first impression might be that every niche has long ago been filled with plants and animals dependent on plants, that the habitats are full to bursting point with life. . . This concept fits plant life fairly well, but it is not true of animals. It is obvious to any naturalist that the total quantity of animal life in any place is an extremely small proportion of the quantity of plant life. This general observation has been amply confirmed by all recent studies of the biomass of animal species or animal communities. For example, the bird life on an acre of rich farm land with trees and hedges and grass and crops may be only a few kilograms in weight. The animal life is widespread, it has, so to speak, staked out its numerous claims, but has seldom succeeded in exploiting them to the full. Only in certain inter-tidal communities of the sea do we feel that animals have reached the limits of the space that will hold them. Even here it is, cosmically speaking, a tiny film of life" (pp. 129-130).

"From this situation we may conclude that, on the whole, animal numbers seldom grow to the ultimate limit set by food-supply, and not often (except in some parts of the sea) to the limits of available space. This conclusion is also supported by the general experience of naturalists, that mass starvation of herbivorous animals is a comparatively rare event in nature. . ." (p. 130).

"Fluctuations occur in every group of animals and in every habitat that has been investigated . . . Although the amplitude of fluctuations is often very great, . . .two things that we might expect do not often happen. The first, complete destruction of vegetation by herbivorous aninals, has already been mentioned. The second is complete destruction over any wide area of either predators or prey" (p. 131).

Thus this specialist in charge of a bureau set up to investigate the matter of animal numbers can find no sign whatever of the Malthus's imagined universal tendency of all living things to multiply and increase beyond the available food supply. The whole Darwinian theory of evolution, basis of all modern biological science and proclaimed on every hand as established fact, rests on something that never was on land or sea.

"Only in certain inter-tidal communities of the sea," says Mr. Elton, "do we feel that animals have reached the limits of the space

that will hold them." We all know these spaces on certain beaches where at low-water we find a mass of pools and living things. What are the commonest objects meeting the eye in such spots ? The answer is, mussels and seaweed. If there is a struggle for existence, mussels' and seaweed are thus in the very mid-centre and vortex of it. Evolution should here be proceeding at top-speed. What are the actual facts? The eminent Professor J. Ritchie in his presidential address to the zoological section of the British Association in August, 1939, handed down the latest bulletin about mussel evolution. He said: "The edible mussel (Cardium edule) has retained its specific characters for two million years or more, its genus in a wide sense lived 160 million years ago in the Trias" (Nature, Sept. 23, 1939). In other words, so far from evolving into something else, the mussel, packed up twenty to the dozen on his perch, has not changed a whisker in two million years, and was a perfectly good mussel 160 million years ago. As for seaweed, we have already noted the statement by Sir J.W. Dawson, that the seaweeds of today are "not very dissimilar from those of the Cambrian and Silurian seas—dating back 600 to 400 million years ago, according to the same fashionable evolutionist chronology. Where is the fabled evolution ?

The great evolution theory falls down flat at the very first hurdle, the supposed struggle for existence. This struggle for existence is affirmed to result in Natural Selection. Very well, we get our evolu-tionist steed up on his feet and start off again. Down he falls once more. "No recognised case of Natural Selection really selecting has bbeen observed," states Professor Vernon Kellogg (vide Major Wren's Evolution, p. 91). That is to say, all sorts of individual variations occur in organisms, but no instance at all is known of individuals with favourable variations supplanting individuals with unfavourable variations.

Let us persevere once more. Natural Selection, according to evolutionist doctrine, results in survival of the fittest. Once more evolution fails to make the jump. "The non-utility of specific characters is the point on which Natural Selection as a theory of the origin of species is believed to fail," says Professor D. H. Scott (Extinct Plants, p. 22), and many other scientists say the same thing. Species are just different in some way from the next nearest species, but no particular usefulness can be discovered in the characteristics distinguishing the one species from the other.

The actual fact of the matter thus appears to be that there is no intense struggle for existence; there is no Natual Selection; and there is no onward and upward evolutionary progress of the more fit re-placing the less fit. Every part of the theory of evolution crumbles away to nothing when examined. These things are the foundations of the whole edifice. In earlier pages we have noted the total absence of evidence that living things can break through their breeding limits.

No such thing has ever been observed, and every attempt to produce it by experiment has failed. Eighty years of fossil-hunting has totally failed to produce the intermediate forms between species which evolution says existed. The imagined embryological evidence of evolution is nowadays rejected by evolutionists as amounting to nothing at all. The vestigial organs, the "plain inutility" of which, to use Darwin's words, showed them to be survivals from past forms of being, are all the time turning out to be useful and not useless : they thus steadily and increasingly vanish as evidence of evolution. From top to bottom there is nothing whatever that will hang together. Evolution is the biggest scientific fraud of all time.

We have noted how Darwin spent twenty-one years collecting matter to support his theory of evolution before he published the Origin of Species at the end of 1859. His letters show quite clearly that even at the end, on the very eve of publication, Darwin had not succeeded in convincing himself. On November 23, 1859, he wrote to Lyell, ". . . Often a cold shudder runs through me, and I have asked myself whether I may not have devoted my life to a phantasy" (Life and Letters, ii, 229). Two days later he wrote to Huxley. "I had awful misgivings, and thought perhaps I had deluded myself as so many have done" (ibid, ii, 232). That was all the actual belief in his theory Darwin was able to muster up with advance copies of his book in the hands of his friends. He saw and knew in his heart that he had produced nothing but a patchwork of incoherent guesses. No man who feels the firm ground of truth beneath his feet writes in such a strain as Darwin wrote in these letters.

Beside his main theory Darwin introduced various subsidiary theories into his books. One such, for instance, that runs through the Origin of Species is that continental animals and plants are more highly evolved by stress of competition than are insular ones; and that continental productions introduced into an island will supplant and replace the less improved native productions. This notion got into Darwin's head apparently at the end of 1858, for he then mentions it in a letter to Hooker, saying, "See how all the productions of New Zealand yield to those of Europe. I dare say you will think all this is utter bosh, but I believe it to be solid truth" (Life and Letters, ii, 143).

In his Naturalised Animals and Plants of New Zealand Mr. G. M. Thomson relates how in the early years of settlement introduced plants and animals flourished exceedingly, water-cress, for example, for a few years growing to 14 feet in length, and then later subsiding to normal size again. Mr. Thomson tells how as an ardent evolutionist he waited to see the introduced vegetation replace and exterminate the New Zealand bush. He states that he waited in vain : "The opinion of all botanists in New Zealand today is that when the direct, or—to a large extent—the indirect influence of man is eliminated, the native

vegetation can always hold its own against the introduced" (pp. 527-8). He says also, "The same probably holds good to some extent with animal life, only the problem is more difficult to follow out."

Darwin's son, Sir Francis Darwin, as editor of his father's Life and Letters said of the paternal propensity for theory-building that "it was as though he were charged with a theorising power ready to flow into any channel on the slightest disturbance" (i, 149). Darwin's elder brother Erasmus wrote back after reading his copy of the Origin: "The a priori reasoning is so entirely satisfactory to me that if the facts won't fit in, why so much the worse for the facts is my feeling" (ii, 233). Darwin's close friend, Sir Charles Lyell, after reading the Origin of Species suggested that in a future edition, "you may here and there insert an actual case to relieve the vast number of abstract propositions" (ii, 206). It is this absence of "actual cases," of course, which is the entire difficulty with evolution. There are no actual cases.

Chapter VII

FROM BOOM TO RACKET

THE Darwinian gospel on its first appearance in 1859 had an im-mediate and world-wide success. Huxley in a contribution to Darwin's Life and Letters (ii, 179) has written wild nonsense about Darwin earning his place, "by sheer native power, in the teeth of a gale of popular prejudice, and uncheered by a sign of favour or appreciation from the official fountains of honour." The fact of the matter is that the London Times on December 26, 1859, devoted no less than the almost unprecedented space of three and a half columns to a highly respectful notice of The Origin of Species, this review, incidentally, being written by Huxley himself. The chorus of praise was so general as to drown dissentient voices. Immediately after his book appeared Darwin is found writing to Hooker, "My head will be turned. By Jove, I must try and get a bit modest." The first edition was sold out on the day of issue and new editions and reprints appeared in quick succession.

In 1864 the Royal Society awarded Darwin the Copley Medal, and Dr. Hugh Falconer in seconding the award described the Origin of Species as having "instantly fixed the attention of mankind throughout the civilised world" (More Letters, i, 255). Within six years of publication of his book Darwin was elected an honorary member of the leading learned societies of eight nations. The position twelve years after the Origin appeared was thus described in Professor St. George's Mivart's Genesis of Species (p. 10) in 1871 : "It would be difficult to name another living labourer in the field of physical science who has excited an interest so widespread, and given rist to so much praise, gathering around him as he has done a chorus of more or less completely acquiescing disciples, themselves masters of science, and each the representative of a crowd of enthusiastic followers." As noted in an earlier chapter, the last scientist to raise his voice against evolution at the congresses of the British Association for the Advancement of Science was Dr. Wright in 1881. By February, 1888, Herbert Spencer, a rival prophet of evolution, was complaining in the Nineteenth Century that "the new biological orthodoxy"—that is, the evolutionist—had become as intolerant as the old, and was rigidly shutting its eyes to everything that did not fit in with the Darwinian

idea of natural selection. The booming of evolution remains the most successful scientific stunt on record.

What was the reason for Darwin's success ? For one thing, he applied to science the gospel of Malthus which had already become the foundation of political economy. Ricardo's theory of rent and his "iron law of wages," etc., and J. S. Mill's similarly inspired writings all received valuable philosophical reinforcement and expansion from Darwin's theory of natural selection and survival of the fittest in the struggle for existence, with a supposed onwards and upwards march to illimitable improvement and progress.

These ideas of Darwin's also enabled any successful man to justify himself to himself in riding rough-shod over his weaker competitors. Such notions were far more comforting teaching than anything to be found in the sayings of Jesus Christ. As John Morley gracefully expressed it in reviewing the Descent of Man in the Pall Mall Gazette in 1871 : "Mr. Darwin's work is one of those rare and capital achievements which effect a grave modification in the highest departments in the realm of opinion" (Darwin's More Letters, i, 324). Everyone in these highest departments was shown by Darwin to be there by survival of the fittest. The idea was naturally completely acceptable in these elevated quarters. No doubt this was another instance of what Darwin's More Letters (i, 71), calls "his supreme power of seeing and thinking what the rest of the world had overlooked." As Darwinism taught that the Bible was all astray in its statements, it also made a wide appeal to those advanced and enlightened people who had had more than enough of the Ten Commandments. There was thus an enormous public ready to receive the comfortable new gospel, and quite willing to overlook the absence of any facts in support of it.

In some quarters there was resistance to Darwin's doctrine. The scientists of France were about the last to be converted, as is recorded in Darwin's Life and Letters (iii, 224). It was not until 1878 that Darwin was elected a corresponding member of the French Institute, and then only on the botanical side. He received 26 votes out of a possible 39. In 1872 an unsuccessful attempt had been made to elect him to the zoological side, but he only got 15 votes out of 48. Nature of August 1, 1872, quoted an eminent member of the Academy as writing in Les Mondes:

"What has closed the doors of the Academy to Mr. Darwin is that the science of those of his books which have made his chief title to fame—the Origin of Species, and still more so the Descent of Man --is not science, but a mass of assertions and absolutely gratuitous hypotheses, often evidently fallacious. This kind of publication and these theories are a bad example, which a body that respects itself cannot encourage."

In Britain and America there were a small number of scientists who refused to accept evolution. Professor Fleeming Jenkin, an engineer, in an article on the Origin in the North British Review in 1867 remarked that Darwin's idea that a species could be modified by a favourable variation occurring in an individual was the same as arguing that the arrival of one ship-wrecked European sailor on an island populated by negroes would result in the population gradually turning white in the course of a century or two (vide Mivart's Genesis of Species, p. 58). Fleeming Jenkin said he did not anticipate this little difficulty would embarrass the "true believer" in evolution, for : "He can invent trains of ancestors of whose existence there is no evidence; he can call up continents, floods, and peculiar atmospheres; he can dry up oceans, split islands, and parcel out eternity at will; surely with all these advantages he must be a dull fellow if he cannot scheme out a series of animals and circumstances explaining our assumed difficulty quite naturally." (Darwin's Life and Letters, iii, 108).

Darwin in the next edition of the Origin set to work and tidily patched up this rent in his theory. He said there could be no doubt that owing to similar organisms being similarly acted on by external conditions, "the tendency to vary in the same manner has often been so strong that all the individuals of the same species have been similarly modified without the aid of any form of natural selection." Any theory needed could be supplied on demand apparently. An analysis of the various repairs effected in the six editions of the Origin would be instructive.

After reading a well-known work by his fellow evolutionist, Herbert Spencer, Darwin wrote to Hooker in 1866 : "I feel rather mean when I read him; I could hear, and rather enjoy the feeling that he is twice as ingenious and clever as myself, but when I feel he is about a dozen times my superior, even in the master art of wriggling, I feel aggrieved . . ." (Life and Letters, iii, 55).

Disbelief in evolution is today regarded as a sign of crankiness and serious mental incapacity. From the five volumes of Darwin's letters one gathers that such disbelief also results in degeneration of character, for those who criticise the great man's views almost invariably appear in these volumes rapidly to develop unpleasant traits in personaility. Sir Richard Owen, the eminent naturalist, commonly suspected of being the author of a severe slating of the Origin in the Edinburgh Review, turns out to be a most unpleasant person, and "mad with envy because my book has been talked about" (More Letters, i, 149). The Edinburgh Review article had the audacity to say, "Lasting and fruitful conclusions have, indeed, hitherto been based only on the possession of knowledge; now we are called upon to accept an hypothesis on the plea of want of knowledge. The geological record is so imperfect! " (ibid, i, 146).

Professor St. George Mivart, F.R.S., suffered a similar deterioration of character after acquiring a disbelief in various parts of the Darwinian theory, expressed by him in review articles and at length in his book of 1871, the Genesis of Species. "He is very unfair," writes Darwin to Lyell. "You never read such strong letters Mivart wrote to me about respect to me, begging that I would call on him, etc., etc. Yet ... he shows the greatest scorn and animosity towards me, and with uncommon cleverness says all that is most disagreeable. He makes me the most arrogant, odious beast that ever lived ... I suppose that accursed religious bigotry is at the bottom of it . . ." (More Letters i, 332).

Mivart in his writings had pointed to various gaps in the Darwinian argument. He remarked, for example, on Darwin's objection to the idea that any special sterility had been imposed on species to prevent inter-mixture. On this point Darwin wrote in the Origin: "To grant a species the special power of producing hybrids, and then to stop their further propagation by different degrees of sterility . . . seems a strange arrangement." Mivart's comment in his Genesis of Species (p. 125) was : "But this only amounts to saying the author would not have so acted had he been the Creator. 'A strange arrangement' must be admitted anyhow . . . and it is undeniable that the crossing is checked . . . there is a bar to the intermixture of species, but not of breeds." This little defect in his theory, as we have seen, was a standing vexation to Darwin, who objected strongly to Huxley obtruding it to public notice.

Darwin held natural selection to operate on chance variations occurring haphazard, and rejected all ideas of design in nature—at any rate subsequent to the First Cause. Mivart noted Darwin asking, "Can it be reasonably maintained that the Creator intentionally ordered . . . that certain fragments of rock should assume certain shapes, so that the builder might erect his edifice ? " Mivart's comment was possibly displeasing to Darwin. "It is almost incredible," he wrote, "but nevertheless it seems necessary to think that the difficulty thus proposed rests on a sort of notion that amidst the boundless profusion of nature there is too much for God to superintend; that the number of objects is too great for an infinite and omnipresent Being to attend to singly to each and all in their due proportions and needs" (Genesis of Species, p. 258). Was this a specimen of Mivart's "accursed religious bigotry" making Darwin appear as he complained, "the most arrogant, odious beast that ever lived" ?

In passing it may be noted that one of Darwin's stock arguments against design in nature was the shape of his nose, which displeased him every time he looked in the mirror. The point recurs in various letters. "Will you honestly tell me (and I shall really be much obliged)" he wrote to Lyell in 1861, "whether you believe the shape of my nose (eheu !) was ordained and guided by an intelligent cause ? " (More

Letters, i, 193). In a letter to Hooker in 1870 Darwin said of the universe, "I can see no evidence of beneficent design, or indeed of design of any kind in the details" (ibid, i, 321).

Professor Adam Sedgwick, the geologist, condemned the Origin of Species emphatically in the Spectator and at the Cambridge Philosophical Society. But the old man was very considerably Darwin's senior, and he was let off by being frozen out of the presence on calling on Darwin some time after his offences. Sedgwick declared quite truly, that the palaeontological record defied the evolutionist at every turn. "I cannot conclude," he wrote in the Spectator, "without expressing my detestation of the theory, because of its unflinching materialism; because it has deserted the inductive track, the only track that leads to physical truth; because it utterly repudiates final causes and thereby indicates a demoralised understanding on the part of its advocates. . . Not that I believe that Darwin is an atheist, though I cannot but regard his materialism as atheistical. . . And I think it intensely mischievous. . . Each series of facts is laced together by a series of assumptions and repetition of the one false assumption. You cannot make a good rope out of a string of air bubbles." (Darwin's Life and Letters, ii, 298).

Louis Agassiz, the American naturalist, in reviewing the Origin, at once put his hand on the weakest spot of all, saying : "Unless Darwin and his followers can succeed in showing that the struggle for life tends to something beyond favouring the existence of some individuals over that of other individuals, they will soon find they have been following a shadow" [Life and Letters, ii, 330). Neither Darwin nor anybody else has ever been able to show this, but eighty years have passed without the scientists being able to perceive that they are following a shadow. Agassiz apparently over-rated the penetration of the scientific mind. As to the theory generally, Agassiz said : "Until the facts of Nature are shown to have been mistaken by those who have collected them. . . I shall therefore consider the transmutation theory a scientific mistake, untrue in its facts, unscientific in its methods, and mischievous in its tendency" (ibid, ii, 184)—"Have you seen Agassiz's weak metaphysical and theological attack ? " wrote Darwin to Huxley (ii, 330).

The foregoing extracts show that the fundamental defects of the theory of evolution were clearly exposed by competent scientific men at the time of its first appearance. These defects remain today, along with numerous others since disclosed. And yet the public has it rammed down its throat on every hand that evolution is an established scientific fact. In the United States, for instance, when Bryan was campaigning against evolution in 1922, the council of the American Association for the Advancement of Science passed a resolution affirming that evolution was "not a mere guess," and furthermore that "the evidences in favour of the evolution of man are sufficient to convince

every scientist of note in the world" (Nature, March 3, 1922). This latter statement was not true: that is, unless regarded as announcement of intention by a scientific ring to treat as a blackleg and scab any scientist who rejected evolution. There is evidence from various quarters of evolution today being run as a scientific racket.

Take the case of a leading biologist like Professor Sir William Bateson, who at the Toronto congress of the American Association for the Advancement of Science in 1921 admitted the total failure of all experiments directed to breaking through the natural breeding limits of species. The weight of this negative evidence against evolution could no longer be ignored, he said. While admitting this, Sir William Bateson nevertheless concluded in loyal evolutionist style : "Let us then proclaim in unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on to this inevitable conclusion. . .The difficulties which trouble the professional biologist need not trouble the layman. Our doubts are not as to the reality or truth of evolution, but as to the origin of species, a technical, almost a domestic problem. Any day that mystery may be solved" (Nature, April 29, 1922). For his candour in referring in various addresses to the lack of evidence of evolution, Sir William Bateson is stated in his biography written by his son to have suffered at the hands of his scientific brethren a grievous ostracism, amounting to a professional boycott.

Professor G. Macready Price, professor of philosophy and geology at Washington, an anti-evolutionist, is quoted as writing : "When my unorthodox college text-book on geology appeared in 1923 it was pounced upon savagely by the scientific journals—or by all that deigned to notice it at all. I was at that time green enough to think that the editors of these journals would allow me to make some sort of reply to my critics. But I had to learn the sad lesson that my offence had placed me beyond the pale. Finally, some years later, I did manage to get a partial reply to two of my critics in the official journal of the scientific society to which I belonged, but only after I had threatened the editor with the proceedings for libel (vide Why Be an Ape ? by a London journalist, Mr. Newman Watts, p. 38).

The way scientists are kicked into line on the subject of evolution was revealed by Mr. Arnold Lunn in his Flight from Reason in 1930. He wrote : "The other day I met a Fellow of the Royal Society. 'I am glad you are taking up this issue,' he said, 'because, of course, we professional scientists can do nothing. Our hands are tied. Take my own case for instance. Professor X regards Darwin as a Messiah. He has good jobs in his gift, and no jobs are going excepting to those who worship at the Darwin shrine.' "

Mr. Lunn also quotes the late Professor Thomas Dwight, an eminent anatomist, as saying : "The tyranny of the Zeitgeist in the matter of evolution is overwhelming to a degree of which outsiders

have no idea. Not only does it influence (as I admit it does in my own case) our manners of thinking, but there is an oppression as in the days of the Terror. How very few of the leaders of science dare tell the truth concerning their own state of mind ! "

A palaeontologist who has rejected evolution is Lieut.-Col. L. Merson Davies, a Fellow of the Royal Society of Edinbrugh, a Fellow of the Royal Anthropological Society, and a Fellow of the Geological Society. Colonel Davies in a Victoria Institute paper, said in 1926 : "It 'does not pay,' as they say, to oppose evolution nowadays . . . how many have heard of the words of a leading zoologist like Fleischmann, a scientist of European reputation, who flatly denied that evolution could be regarded as scientifically established ? It is significant that no one has ever undertaken the task of directly opposing Fleischmann; but he was thoroughly abused instead, and soon forgotten. When men of science find that open expression of serious doubts upon the subject is treated after this fashion it is natural that they incline to keep them to themselves. Although the great majority of scientific workers do certainly accept belief in evolution, we have no reason to suppose they all do, even if we seldom hear of them openly opposing it" (vide Dewar's More Difficulties, pp. 124-5).

Mr. Douglas Dewar, F.Z.S., tells how the press has been nobbled up so that the public never hears the truth about evolution. Mr. Dewar was an evolutionist up to 1931, when he published his first book against the theory. In 1912 he was co-author with Mr. F. Finn of an evolutionist book, The Making of Species, which was specially commended by President Theodore Roosevelt. In later life Mr. Dewar whose subject is Indian birds, rejected Darwinism in favour of evolution by sudden mutations. In the end he rejected the entire theory. He writes in his Man, a Special Creation (pp. 103-4) :

"Few people realise how important has been the capturing of the press by evolutionists. Today very few periodicals will publish an article or a paper attacking the evolution theory, and this applies both to the lay and the religious press : most of the religious journals are in the hands of modernists who have accepted the theory of man's animal descent . . . Generally speaking the editors of newspapers believe evolution to be an established fact, and in consequence regard anyone who attacks it as an ignoramus or crank . . . Scientific journals, being conducted by evolutionists, usually decline to publish any contribution that casts even a shadow of doubt on the evolution concept. . . Book publishers . . . are unwilling to publish a book, which as it runs counter to current scientific opinion will either be ignored or savagely attacked. Nor are most of them willing to publish at the author's expense a volume attacking evolution for fear they should lose caste. Thus the public is permitted to hear only one side of the case .... the average man ... is led to believe that evolution is a law of nature as firmly established as is the law of gravity."

As an instance of how Britain's leading scientific journal deals with anti-evolutionists the following facts may be mentioned. The present writer in looking through a file of Nature noticed in its issue of November 27, 1937, a half-page review of Evolution and Its Modern Critics by Dr. Morley Davies. This book was a rejoinder to Mr. Douglas Dewar's Difficulties of the Evolution Theory published in 1931. In 1938 Mr. Dewar replied to Dr. Davies with another book, More Difficulties of the Evolution Theory. Inspection of the very full index to Nature revealed no review of either of Mr. Dewar's two anti-evolutionist books. Most of Nature's review of Dr. Davies' book was occupied with belittlement of Mr. Dewar. Said the reviewer : "In place of a hypothetical discussion, the author takes Mr. Dewar's Difficulties of the Evolution Theory in place of a young student's questions." Having thus by inference written Mr. Dewar down to the to the intellectual level of an immature student, Nature's reviewer proceeded to give him a kindly lecturette on the extreme rarity of fossilisation, suggesting that if Mr. Dewar watched a dog pulling an animal carcase to pieces he might have some elementary ideas on the subject. In point of actual fact, Mr. Dewar and Mr. Levett-Yeats, as we have noted, had five years before contributed a paper to the Victoria Institute giving detailed statistics on this subject of fossilisation. However, the last thing any reputable scientific journal desires today is to allow anything injurious to evolution to creep into its pages.

Testimony as to a similar state of things in the United States was provided by Mr. Paul Shorey in an article in the Atlantic Monthly in 1928. "There is no cause," wrote Mr. Shorey, "that is so immune from criticism, that is so sacred a cow, not only in newspaper offices but in the universities of the North (of America), as Evolution with a capital E. An ambitious young professor may safely assail Christianity or the Constitution of the United States, or George Washington, or female chastity, or marriage, or private property. But he must not apologise for Bryan. . . That would be intolerance, lack of a sense of proportion, failure in open-mindedness, unfaith in progress. It is not done."

In Britain in 1934 an Evolution Protest Movement was formed and presently requested the British Broadcasting Corporation that its president, Sir Ambrose Fleming, F.R.S., might be given an opportunity of stating the case against evolution over the radio. Mr. C. A. Siepmann, the B.B.C. director of talks, refused this, stating in his reply : "It is the policy of the Corporation to allow of reference to evolution in such terms as have the support of the large majority of distinguished scientists in this country." An Evolution Protest Movement leaflet notes that while taking this stand to block an anti-evolution broadcast, the B.B.C. nevertheless defended a communist broadcast on the ground that "there was no greater danger than that

a point of view should be suppressed." Curiously enough, it was only by the invention of the thermionic valve by Sir Ambrose Fleming, whom the B.B.C. refused to allow to speak, that radio broadcasting became possible at all. The incident is significant as just one more instance of evolutionist and communistic influences operating in double harness in influential quarters.

Chapter VIII

ALL ABOARD FOR ATHEISM

EVER since its first proclamation eighty years ago, the theory of organic evolution has been actively at work disintegrating the religious beliefs of those who accept it. Its principal achievement has been to empty the churches by mass manufacture of atheists and materialists. Atheism and materialism very frequently find their political embodiment in communism. It is not correct to say that all evolutionists are atheists, materialists, and communists. They are simply headed that way, that is all. It is correct on the other hand, to say that communists are almost invariably atheists, materialists, and evolutionists. Evolution is essential to materialism and atheism in that it provides a mechanical explanation of the universe without any spiritual principle.

Both Darwin, prophet of evolution, and Huxley, his high priest, had abandoned belief in Christianity at the time they took up with evolution. Darwin records that after his return from the voyage in the Beagle in 1836, at which date he was twenty-seven years of age, "I gradually came to disbelieve in Christianity as a divine revelation" (Life and Letters, i, 308). Huxley similarly relates that by 1850, at the age of twenty-five, he had "long done with Pentateuchal cosmogony," and desired "some particle of evidence" that animals came into being by creation (ibid ii, 187-90). That neither held established religion in especial esteem is evident by their letters. Darwin in 1859, for instance, wrote to Hooker complaining that a certain reviewer of his book "drags in immortality, and sets the priests at me," and is ready to "tell the black beasts how to catch me" (ibid, ii, 228). Huxley's attitude was well known, and right at the end within a year of his death he wrote in 1894 : "I am not afraid of the priests in the long run. Scientific method is the white ant which will slowly but surely destroy their fortifications," and lead to "the gradual emancipation of the ignorant upper and lower classes, the former of whom especially are the strength of priests." (Huxley's Life and Letters, ii, 379). The word "priests" in these extracts is used as descriptive of clergy generally, irrespective of denomination.

Huxley expounded his theological views publicly and emphatically in his addresses and books. Darwin did not do so. In various

letters he is to be found stating, "My theory is in a muddle." The fact of the matter seems to be that his own intuitive feelings for a long time prevented him from carrying his scientific views to their logical conclusion. According to the Darwinian theory of natural selection all living things are the product of chance variations without purpose or design. Modern evolutionists carry the idea a stage further, regarding life itself as a chance product of inorganic matter. Darwin for a long time refused to accept this idea, but in 1871 he is to be found imagining a chance generation of life from non-living matter—"in some little warm pond, with all sorts of ammonia and phosphoric salts, light, heat, electricity, etc." (Life and Letters, iii, 18).

As he advanced in life, Darwin became more completely materialistic in his views. Less than two months before his death he wrote on February 28, 1882 : "Though no evidence worth anything has as yet, in my opinion, been advanced in favour of a living being, being developed from inorganic matter, yet I cannot avoid believing the possibility of this will be proved some day in accordance with the law of continuity. . . Whether the existence of a conscious God can be proved from the existence of the so-called laws of nature (i.e., fixed sequences of events) is a perplexing subject, on which I have thought, but cannot see my way clearly" (More Letters, ii, 171). The chaotic nature of Darwin's views is revealed in the following statement made in 1879 :

"The old argument from design in Nature, as given by Paley, which formerly seemed to me so conclusive, fails now that the law of natural selection has been discovered. . . There seems to be no more design in the variability of organic beings, and in the action of natural selection than in the course which the wind blows. . . At the present day the most usual argument for the existence of an intelligent God is drawn from the deep inward convictions and feelings which are experienced by most persons. . . Formerly I was led by such feelings ...to the firm conviction of the existence of God and the immortality of the soul. . . I well remember my conviction that there is more in man than the mere breath of the body. But now the grandest scenes would not cause any such conviction and feelings to rise in my mind. Another source of conviction in the existence of God. . . follows from the extreme difficulty, or rather impossibility, of conceiving this immense and wonderful universe, including man and his capacity for looking backwards and far into futurity, as the result of blind chance or necessity. . . This conclusion . . . has gradually, with many fluctuations, become weaker. . . I, for one, must be content to remain an Agnostic" (Life and Letters, i, 309-12).

In 1881 Darwin was asked if a certain correspondent was correct in describing him as saying everything was due to chance. Darwin replied that the word "chance" must have been used "in relation only to purpose in the origination of species." He added : "On the other

hand, if we consider the whole universe the mind refuses to look at it as the outcome of chance—that is, without design or purpose. The whole question seems to me insoluble, for I cannot put much or any faith in the so-called intuitions of the human mind, which have been developed, as I cannot doubt, from such a mind as animals possess; and what would their convictions or intuitions be worth ? " (More Letters, i, 395).

Darwin's position was that whatever the First Cause of all things might be, everything thereafter occurred by chance. Alfred Russell Wallace and Sir Charles Lyell accepted evolution subject to in-breathings of creative power to help the process on, particularly with respect to the appearance of man upon the earth. Wallace regarded natural selection as quite incapable of accounting for man's powers of speech, his taste for music, mathematical faculty, and other attributes separating him by an immense gulf from the lower animals, and in his Darwinism in 1901 Wallace imagined evolution helped along by creative power from time to time just as the direction of a curve is imperceptibly altered. Lyell in correspondence with Darwin in 1859 had raised the same point of injections of primeval creative power, and Darwin replied, "If I were convinced that I required such additions to the theory of natural selection, I would reject it as rubbish" (Life and Letters, ii, 210).

Huxley, with his endless capacity for writing nonsense, rebuked the critics of Darwin for "the most singular" of their fallacies, "that which charges Mr. Darwin with having attempted to re-instate the old pagan goddess, Chance" (Darwin's Life and Letters, ii, 199). Nevertheless, one finds Sir Edward Poulton in his presidential address to the British Association in 1937 recalling the "heroic help" given in the study of Darwinian natural selection by Miss Welldon "who four times recorded the result of 4,096 throws of dice, showing that the faces with more than three points were, on the average, uppermost slightly more often than was to be expected" (Nature, Sept. 4, 1937). According to evolutionists, chance developed the human eye by the operation of discontinuous light on a freckle on the skin. Chance is the only God evolution knows.

Huxley, chief propagandist of Darwinism, expressed himself with frequency and vigour on theological matters. He saw not a tittle of evidence, he said, of a Deity standing to mankind in the relationship of a father. "I am unable," he declared, "to discover any 'moral' purpose, or anything but a stream of purpose towards the consum? mation of the cosmic process, chiefly by means of the struggle for existence, which is no more righteous or unrighteous than any other mechanism" (Huxley's Life and Letters, i, 241, and ii, 303).

Darwin's moral ideas were based on his evolutionist doctrine. He expressed the opinion in 1879 that "most or all sentient beings have been developed in such a manner, through natural selection,

that pleasurable sensations serve as their habitual guides" (Life and Letters, i, 310). Morality on this basis slides easily and naturally into the doctrine of Aleister Crowley and the Black Mass, 'Do as thou wilt, there is no other law.' The so-called new morality runs along these lines, and the same idea (wrapped in cotton wool) is at the back of the new education, etc.

While Darwin became increasingly materialistic in his views in later life, Huxley became less so. However, one finds Huxley writing on the subject of morality as follows in 1892 : "So far as mankind has acquired the conviction that the observance of certain rules of conduct is essential to the maintenance of social existence it may be proper to say that 'Providence,' operating through man, has generated morality" (Huxley's Life and Letters, ii, 303). Huxley in his Romanes lecture of 1893 admitted that the ethical principle of disregard of self is opposed to the self-regarding principle on which evolution is assumed to have taken place. Huxley also admitted that natural selection fails to account for man's taste for music and his innate sense of moral beauty.

Enough has been quoted of the views of Darwin and Huxley to show the deteriorating effect of their evolutionist imaginings on their entire outlook on life. They are adrift from whatever bearings they ever had, and without any idea of where they are. Their moral standards, so far as they have any clearly defined standards, are inferior to the Christian ones they threw away. Their idea of man as descended from brute beasts is a degraded conception as compared with the conception of man as a spiritual being; and the Darwinian idea of the living world as a chance product without aim or purpose is one which runs counter to the intuitions of mankind. If what they had to tell us was true we should have to accept it and reconcile ourselves to it as best we could. But the standards of proof accepted by evolutionist scientists would be despised by a mediaeval witch finder. The late Lord Halsbury, a former Lord Chancellor of England, has been quoted as very truly saying : "In court we are expected to give full proof in support of every assertion. A professor, on the other hand, appears to consider himself relieved of any such anxiety" (vide Why be an Ape?, p. 34).

Evolution is an emanation of darkness, a product of a decadent age. A passage in Huxley's Life reveals the progress of that decadence. In expounding his theological views in correspondence with Charles Kingsley in 1863, Huxley remarked that, except with two or three scientific colleagues, he felt himself helplessly at variance with his fellowmen on these matters, and as remote from them as they would feel among a lot of Hottentots. He added : "I don't like this state of things for myself—least of all do I see how it will work out for my children" (Huxley's Life and Letters, i, 240). Huxley need have had no fear. The evolution boom swept him and his family onward and upwards. Nine years after he wrote the University of St. Andrews

recognised his eminence by electing him its rector. Oxford University later acclaimed him as one of the great men of the day by bestowing an honorary D.C.L. Finally, in 1892 Queen Victoria (or her Ministers) thought it not inappropriate for the Defender of the Faith to summon this active and noisy propagator of disbelief to membership of her Privy Council.

As for the Huxley family, they have flourished mightily in preaching the same Huxleian gospel. In 1899 the evolutionists, in their task of emancipating the ignorant upper and lower classes from thraldom to religion, founded the Rationalist Press Association. Seren years later that body was busy pushing out in scores of thousands a book of 432 pages sold at the obviously unprofitable price of sixpence, and proudly flaunting on its cover an excerpt from the Sunday School Chronicle quoting the Bishop of London as saying that this particular book "has done more damage to Christianity during the last few years than all the rest of the sceptical books put together." Inside the cover appeared the name of Professor Leonard Huxley, son of the great Huxley, as one of the executive officers of the association.

In the third generation Huxley's grandson, Professor Julian Huxley, is able triumphantly to proclaim in his widely circulated Essays of a Biologist (p, 74) that "any view of God as a personal being is becoming frankly untenable."The "march of knowledge," he affirms, has left no room in the universe for any such idea. "Creation of earth and stars, plants, animals and man—Darwin swept the last vestiges of that into the wastepaper basket of outworn imaginations, already piled high with the debris of earlier ages," so affirms this worthy scion of the House of Huxley.

It is worth noting that evolution is the mainstay of the Rationalist Press Association volume of which Professor Julian Huxley's father was one of the sponsors. The volume, The Churches and Modern Thought by Philip Vivian, solemnly assures us without a quiver of an eyelid that "Evolution is no longer a mere speculative theory, possibly or probably true, but an established fact accepted by the whole scientific world with hardly a single dissentient voice " (p. 169). In putting Christianity through the mincing machine, the author dwells on the pitiful lack of evidence on the religious side. "Even the working man," he tells us, "will not remain satisfied with a theology which maintains the necessity for a foundation of facts, and yet is unable to prove them" (p. 361). With gusto he quotes on page 339 the following statement from T. H. Huxley's essay on "Science and Morals" : "The foundation of morality is to have done, once and for all, with lying; to give up pretending to believe that for which there is no evidence. . ."

If evolutionists were to follow Grandfather Huxley's advice, and give up pretending to believe that for which there is no evidence, not very much would be left of their theory. Even prominent evolutionists in pronouncements from the throne in the scientists' parliament have

declared evolution to be just as much a matter of faith as religion. The eminent Professor D. H. Scott, for example, in his presidential address to the botanical section of the British Association in 1921 is to be found saying : "Is then evolution a scientifically ascertained fact ? No ! We must hold it as an act of faith because there is no alternative." Eight years later Professor D. M. S. Watson, of the University of London, told the assembled zoologists of the British Association in 1929 : "The theory of evolution is a theory universally accepted, not because it can be proved true, but because the only alternative, special creation, is clearly incredible."* The facts assembled in these pages suggest strongly that Professors Scott and Watson had excellent grounds for saying no evidence can be found of evolution. The fact of the matter is simply that the Huxleys, Vivians, and the rest, approach evolution in a spirit of credulity and religion in a spirit of incredulity.

It is noticeable that both Professor Julian Huxley and Mr. Vivian attach importance to the number of believers as an item of proof of evolution. Professor Huxley, as previously noted, opens the 1929 Encyclopaedia Britannica article on evolution by telling us that "among competent biologists and geologists, there is not a single one who is not convinced," etc. Mr. Vivian proclaims evolution as "accepted by the whole scientific world with hardly a dissentient voice." On the other hand, we have noted various qualified scientific men stating that it 'does not pay' today to express disbelief in evolution, and that the scientific billets only go to professing evolutionsts.

The proposition thus seems to run : (1) Evolution is established fact. (2) It is established because scientists believe in it. (3) Scientists have to believe in evolution to rise on the payroll. The reader can draw his own conclusion from these premises. There is certainly no pecuniary sacrifice attaching to belief in evolution today. It is a suitable belief for a scientist desirous of presently possessing a higher-grade motor car. And pursuit of truth for truth's sake is a cold, cheerless occupation compared with going places in a limousine. You travel in pursuit of truth on a secondhand push-bicycle.

"Materialism," says Professor John Elof Boodin, in his Cosmic Evolution (1925), "has substituted magic for sober thought. The whole process of evolution becomes a succession of miracles without intelligible ground in the process. The appearance in a world of chance of any order at all, the emergence of life with its series of forms and organs, the final appearance of intelligence and a sense of beauty— all are miracles. . . That any age should take seriously such an incoherent mixture of mysticism and science is evidence of nothing so much as a want of logical thinking. . . By some magic the antecedent

* Professors Scott and Watson are quoted in Major Wren's Evolution: Fact or Fiction? pp. 22 and 59. Nature's reports of their addresses, apparently condensed, are to similar effect in less direct language.

forms are supposed to yield new forms and characters. By chance variations the structure of protoplasm is supposed to be built up from inorganic matter, and by further chance the various forms and characters appear. . . Chance is God. . . Materialism offers the most astounding instance of credulity in history" (extracts quoted in Major Wren's Evolution, Fact or Fiction ?).

Evolution is not a science at all. It is a religion, and a very low-grade religion, with its hymns played in jazz and syncopated cacophony, and its sanctuaries adorned with cubist art—the religion of the Godless, of the crazy intellectuals who don't know anything about anything except knowledge. A few faint gleams of light begin to appear through the murk of this evolutionist hell-upon-earth. A stray scientist here and there begins to perceive that knowledge is not all. Professor Sir Arthur Eddington, peering out into space through his astronomical telescope, perceives something else looming into view. "The problem of knowledge," he writes, "is an outer shell beneath which lies another philosophical problem—the problem of values" (Philosophy of Physical Science, 1939, p. 222).

With their heads stuffed full of what they call knowledge our materialist-evolutionist intellectuals have lost all sense of values. They forget that the human rational intellect is but a measuring machine capable of reporting on the difference between this and that, but dealing all the time with nothing but the symbols of reality. Not all the books and all the professors in the world can even tell you the taste of bacon and eggs, you have to eat a dish of them to find that out. Rationalism gives you the menu card and calls it a dinner. It hands you the music score and calls it a concert. Your contact with reality comes through other parts of your consciousness.

Rationalism cannot measure God Almighty, cannot weigh Him : therefore God Almighty does not exist. But as William James, the psychologist, points out* the innumerable men and women who in all ages have felt the presence of God behind phenomena need no logical demonstration to prove that God exists : they know that all the words in all the creeds and religions of the world are but the feeblest shadow of a tremendous fact. Not all men have this insight, but the intuitive feeling that there is an omnipresent power in the universe, outside and beyond man, yet friendly to him and his ideals, has endured in the human heart through all ages and in all lands.

The evolutionist-materialist says these intuitions are superstitious delusions. He wants logical proof before he believes in anything but his material world. But the materialist has yet to be born who can provide any logical proof that the material universe has any existence apart from his own consciousness of it. When it comes to logical foundations he is as hopelessly bankrupt as his opponent. It all comes down to the practical working value in human life of the goods that

* Varieties of Religious Experience, pp. 73 and 443.

evolutionist-materialism and religion have to offer. We hear a lot about "Democracy" today. A very valuable book entitled Modern Democracies was written a few years after the war of 1914-1918 by the late Lord Bryce. After surveying the democracies of the world as they then stood, Lord Bryce expressed the opinion that the future or civilisation depends upon the future of religion. Of Christianity he said :

"Christianity—a far more powerful force than any political ideas or political institutions, since it works on the inmost heart of man— has produced nearly all the moral progress that has been achieved since it first appeared, and can in individual cases transmute lead into gold; yet Christianity has not done these things for peoples, because checked or perverted by the worse propensities of human nature, it has never been applied in practice" (vol. ii, p. 585).

What has Darwinian monkey-man materialism produced since it first appeared? Nothing but dirt and degradation all along the line. No one is twopence the better for it. What is it based upon. Upon nothing whatever but faith, upon belief in the reality of the unseen-belief in the fossils that cannot be produced, belief in the embryo-logical evidence that does not exist, belief in the breeding experiments that refuse to come off. It is faith unjustified by works—"fanatic faith, that wedded fast to some dear falsehood, hugs it to the last." Whether we seek our ancestors in the Garden of Eden or the monkey-house, it is faith that guides us equally to the one quarter or the other : upwards to the stars and immortal harmonies beyond this muddy vesture of decay; or downwards to the dark earth and the beasts that perish.

Chapter IX

EVOLUTION'S OFFSPRING

IN CURRENT thought today everything is assumed to be in a state of evolution into something else. The theory of organic evolution is not only treated as a fact, but has been made the basis of a philosophy which has invaded every branch of knowledge, and every side of life. This assumed evolutionary change is associated with the idea of progress and an inevitable onwards and upwards movement. The net result of the propagation of evolutionary ideas is, first and foremost, to lower the public resistance to change. The propagation of evolution is thus of the highest advantage to those who, for their own reasons —which are not necessarily those publicly proclaimed by them—wish to effect a revolutionary overthrow of existing institutions. Their battle is half won if they can succeed in propagating the idea that everything is in a state of inevitable and automatically beneficial evolution. In modern parlance, evolution is first-class revolutionary sales talk.

The pioneer in this evolutionary philosophy—himself very far from being a revolutionary—was Herbert Spencer. He embarked on the undertaking a few years before Darwin's Origin of Species appeared, and devoted most of a long life to it. The results were embodied in the ten ponderous volumes of his System of Synthetic Philosophy, treating of first principles, biology, psychology, sociology, and ethics. It is significant that in applying evolutionary principles to the universe at large, Herbert Spencer passed over inorganic nature. He admitted that logically a treatise on evolution in inorganic nature should have followed next after his First Principles, but excused himself on the ground that "even without it the scheme is too extensive," and also evolution in organic nature is "of more immediate importance" (Epitome of Synthetic Philosophy, p. 65).

An additional reason for the omission of this portion of the Spencerian philosophy may possibly have been the fact that science appears to be unable to discover any trace whatever of the assumed universal, onwards and upwards, integrative principle of evolution at v/ork in inorganic nature. "Whatever a star's evolution may be," says Sir James Jeans in The Universe Around Us (p. 306), "it is essential that it should always be down the steps : any upward step is impossible." The sun, for example, is reported by science to be always

losing energy without full recovery. Turning from stars to atoms, the scientific report is that the largest and heaviest among the atoms (such as radium and uranium) are continually breaking up of themselves; and some atoms have been broken up artificially. But nothing is known of any process of building up the higher-class atoms out of simpler elements. Dr. F. Soddy, professor of physical chemistry at Oxford University, in his contribution to Evolution in the Light of Modern Knowledge (pp. 401-4) says there is no reason to suppose the simpler atoms came first and the complex ones afterwards, or that one atom is the parent of another. "Can one honestly see even a trace of that consecutive progress. . . reflected in the ways of the material universe ? " he asks.

In discussing this matter of inorganic nature and evolution in his book The Bible Confirmed by Science (from which the above excerpts are taken), Dr. W. Bell Dawson noted the contention in 1930 of Dr. R. A. Millikan that "cosmic radiation" indicates that atoms are being built up in inter-stellar space. Dr. Dawson remarked that such a view could not be definitely verified, and that Sir James Jeans in his Mysterious Universe (pp. 75-6) showed the probabilities to be enormously against it. That the Millikan idea remains purely supposititious is indicated from Nature's report of Professor P. M. S. Blackett's Kelvin Lecture on "Cosmic Rays" before the Institution of Electrical Engineers on April 27, 1939. Professor Blackett is reported as saying, "There is little exact knowledge about these rays, and it is assumed that they are due to radiation from the extra-solar universe." If it is only assumption that the cosmic rays come from the extra-solar universe, it presumably requires an extra large dose of evolutionist faith to spring the further assumption that cosmic rays are evolving atoms there. Except for this unverified idea, it seems to be correct to say that science knows nothing of evolution in inorganic nature.

It thus appears that Herbert Spencer might have included a treatise on "The Principles of Inorganic Evolution" in his vast work with no more labour than was involved in the famous chapter Ixxii "Concerning Snakes," in Horrebow's Natural History of Iceland, the whole truth of which reads exactly thus : "There are no snakes to be met with throughout the whole island." The reader will recall that the great Darwin himself, after reading a volume of the Spen-cerian philosophy described Herbert Spencer as "about a dozen times my superior, even in the master art of wriggling." Nevertheless, if evolution is a universal principle it should be able to explain how material things came to be. Professor Sir William Bateson admitted this, saying "Every theory of evolution must be such as to accord with the facts of physics and chemistry : a primary necessity to which our predecessors paid small heed" (vide Dr. W. Bell Dawon's Is Evolution True ? No. 2, p. 8). Once again our evolutionist steed collapses at the hurdle.

If the great integrative principle of evolution could not be applied

to inorganic nature, it was, however, applied to everything else. The evolutionist dram-drinker soon found himself "seeing things," and with respect to man in particular. Huxley, accepting evolution as a fact, and accepting man's descent from the lower animals as a fact, found himself in sight of various illuminating consequential facts. As dispenser-in-chief of the Darwinian distillation, the aged Huxley in 1893 solemnly got on to his feet, and rammed the following statements down the throats of the callow undergraduates of Oxford in his Romanes Lecture of that year :

"Man, the animal, in fact, has worked his way to the headship of the sentient world, and has become the superb animal he is, in virtue of his success in the struggle for existence ... the self-assertion, the unscrupulous seizing upon all that can be grasped, the tenacious holding of all that can be kept, which constitute the essence of the struggle for existence, have answered. For his successful progress, throughout the savage state, man has been largely indebted to those qualities which he shares with the ape and the tiger; his exceptional physical organisation; his cunning, his sociability, his curiosity and his imitativeness; his ruthless and ferocious destructiveness when his anger is aroused by opposition . . . after the manner of successful persons, civilised man would gladly kick down the ladder by which he has climbed."

There are no "ifs" and "ands" in this Huxleian pronouncement. All is as real and visible as the pink snakes crawling over the counterpane. Unfortunately, the archaeologists, looking in the ground for their facts instead of drawing upon their imaginations for them, appear to be finding evidence that civilised man was in existence all the time. One finds an eminent archaeologist, Dr. A. H. Sayce of the University of Oxford, quoted as saying: "Neither in Egypt nor in Babylon has any beginning of civilisation been found. As far back as archaeology can take us, man is already civilised, building cities and temples, carving stone into artistic form, and even employing a system of picture writing; and of Egypt it may be said, the older the country, the more perfect it is found to be. The fact is a very remarkable one, in view of the modern theories of development, and of the evolution of civilisation out of barbarism. Whatever may be the reason, such theories are not borne out by the discoveries of archaeology. Instead of the progress we should expect, we find retrogression and decay; and where we look for the rude beginnings of art, we find an advanced society and artistic perfection. Is it possible that the Biblical view is right after all, and that civilised man has been civilised from the outset ? " (vide Dr. W. Bell Dawson's The Bible Confirmed by Science, p. 141).

In Germany, the modernists in the Church and the socialists outside it, both took up with Darwinism at an early date. On it also Frederick Nietzsche built up his philosophy of Prussianism. "Nietzsche was the child of Darwin," says Dr. Will Durant in his Story of

Philosophy. Darwin, Durant says, swept away the last remnant of the theological basis of modern morals, and "men who could think clearly soon perceived . . . that in this battle we call life, what we need is not goodness but strength, not humility but pride." Nietzsche contended that just as man had evolved from an ape-like ancestor, so a higher type "superman" would evolve from man. Here are a few Nietzschean pearls of wisdom :

"We . . . believe that [man's] will to Life had to be intensified into unconditional Will to Power; we hold that hardness, violence, slavery, danger in the street and in the heart, secrecy, stoicism, arts of temptation and devilry of all kinds; that everything evil, terrible, tyrannical, wild-beast-like and serpent-like in man contributes to the elevation of the species just as much as the opposite—and in saying this we do not even say enough."—Beyond Good and Evil, sec. 44.

"Ye say it is the good cause which halloweth even war ? I say unto you, it is the good war, which halloweth every cause."—Thus spake Zarathusa, "War and Warriors."

"One must . . . resist all sentimental weakness : life is in its essence appropriation, injury, the overpowering of whatever is foreign to us and weaker than ourselves, suppression, hardness, the forcing upon others of our own forms, the incorporation of others, or, at the very least and mildest, their exploitation."—Beyond Good and Evil. sec. 259.

"We children of the future … do not by any means think it desirable that the kingdom of righteousness and peace should be established on the earth ... we count ourselves among the conquerors; we ponder over the need of a new order of things, even of a new slavery—for every strengthening and elevation of the type 'man' also involves a new form of slavery."—The Joyous Wisdom, sec. 377.

Huxley held cunning and ruthlessness to be the means by which man had ascended from beast, according to the Darwinian hypothesis. Nietzsche arrived at exactly the same idea from the same source, and as a practical-minded person urged his fellow Germans to carry on with the good work and joyously evolve into the "Super-man," "the blond beast, lustfully roving in search of booty and victory." Darwin's and Huxley's countrymen have since been engaged in two expensive efforts to remove this Darwinian inspiration from the German intellect.

Marxian socialism, like its stable companion atheism, with which it is usually to be found jogging along in double harness, has drawn sustenance freely from the evolutionary nosebag. Karl Marx (original family name Mordecai) produced his original programme of revolutionary violence in his Communist Manifesto of 1848, and the first volume of his theoretical justification of it, Das Kapital* in 1867. In this he drew largely on Malthusian ideas, via Ricardo. His financial

* It was to Darwin that Marx wished to dedicate Das Kapital. With characteristic tact, Darwin declined the honour. (Editor).

backer and collaborator, Engels, in his celebrated oration over the grave of Marx, declared Marx and Darwin to be twin discoverers of the law of evolution, saying : "Just as Darwin discovered the law of evolution of organic nature, so Marx discovered the evolutionary law of human history—the simple fact that ... the production of the material necessities of life and the corresponding stage of economic evolution of a people or a period provides a foundation upon which the national institutions, legal systems, art, and even the religious ideals of the people in question have been built, and upon which, therefore, their explanation must be based."

Numerous quotations showing the close tie-up between evolution and revolutionary socialism appear in Mr. Dan Gilbert's excellent little book Evolution: the Root of All Isms from which the foregoing is quoted. Enrico Ferri, the Italian socialist leader, asserted in his Socialism and Modern Science that Marxian socialism "is nothing but a vital and logical corollary in part of Darwinian, in part of Spencerian, evolution." Said Karl Kautsky, German socialist leader : "For Marx, on the other hand, the class struggle was but a particular instance of the universal law of evolution, whose essential qualities are in no case peaceful." The American socialist, Morris Hillquit (real name Hilkowicz) said in his Socialism in Theory and Practice: "Karl Marx alone consistently introduced the spirit of Darwinism into the study of social phenomena by substituting the . . . doctrine of the class struggie in the more modern stages of social development for the . . . doctrine of the struggle for existence in its lower stages." Hillquit proceeds to lay it down that "in the ascending scale of organic existence the struggle between individuals of the same species gradually abates and is superseded by collective struggles of such individuals."

The various socialist writers, after imbibing at the evolutionary fountain, arrive at very similar views to those of Nietzsche as to the morality of the whole business. Survival is the evolutionary test of fitness, and anything which helps to survival is moral. Here are a few flowers of socialist thought along these lines of evolutionist morality :

"All the factors which impede the path to its [socialism's] approximate realisation are anti-ethical or immoral; contrariwise, all factors or movements which tend in its direction are ethical."—Morris Hillquit, noted American Socialist, in his Socialism in Theory and Practice.

"The socialist has a distinct aim in view. If he can carry the initial stages towards it by means of the count-of-heads majority, by-all means let him do so. If, on the other hand, he sees the possibility of carrying a salient portion of his programme by trampling on this majority, by all means let him do this also."—E. Belfort Bax, noted English socialist, in his Ethics of Socialism.

"The dictatorship of the proletariat is nothing else than power

based upon force and limited by nothing—by no kind of law and by absolutely no rule."—Lenin, Complete Works, vol. xviii, p. 361.

"The class-war is not only to continue, but must be carried on with considerably increased intensity. The classes inimical to the workers are, it is true, beaten, but the individuals continue to exist. They have not all of them been shot as yet, not all of them have been caught, not all of them have been physically annihilated. The carrying out of this task lies before us."—Krylenko, principal public prosecutor of the Soviet Union, in May, 1934.

The foregoing excerpts appear among others in Mr. Gilbert's book to which reference has been made. They could be multiplied indefinitely. Everything is based upon the evolutionist line of thought of the survival of the fittest in the struggle for existence—that which succeeds, anything that pays, is moral. The socialistic authors quoted exhibit exactly the same moral ideas as underlie Nietzsche's Prussian-istic philosophy, and both are derived from the same source.

The tie-up between evolutionary scientists and Bolshevism is notorious. According to London press statements of July, 1940, Professor J. B. S. Haldane, noted evolutionist, was then chairman of the editorial board of the Daily Worker, official organ of the Communist Party of Great Britain, and which, according to Lord Newton in the House of Lords on June 13, 1940, had "done all it can to impede the war effort of the Government."

In his references to the file of Britain's leading scientific journal Nature, the present writer noticed in its issue of May 23, 1936, three and a half of its foremost pages devoted to a glowing review of a new book, Soviet Communism* by Sidney and Beatrice Webb. This book is a whitewashing of Bolshevism by two English socialists who have spent the last half-century in percolating socialism, via the Fabian Society, into the British upper classes, civil service, and universities. The book was outside the usual range of topics of a purely scientific journal, and the present writer in turning over the files of Nature did not chance to encounter reviews of books critical of Bolshevism. Nature declared the Webbs' book to be "a work of ultimate significance to the English-speaking world"; and the Bolshevik revolution itself is described as "an event in human history like the spiritual emancipation that came with Christianity and the political emancipation that culminated in the French Revolution." This scientific journal thus showed itself ready to go out of its way to use its pages

*Beatrice Webb in "Our Partnership," p. 491, categorically affirmed that Soviet Communism was the work of her husband and herself. But the one-time Soviet Army officer, Colonel Bogolepov, who fled to the West, giving evidence before The Internal Security Sub-Committee of the United States Senate Committee of the Judiciary on April 7th, 1952, stated that the entire text of the Webbs' book had been prepared in the Soviet Foreign Office. The Colonel explained that he had done most of the ghost-writing himself in the line of duty.

(Editor).

as a vehicle for communist propaganda in the university and other circles in which it circulates.

Evolutionist worship of Bolshevism is reciprocated by Bolshevist worship of evolution. Evolution is a mainstay of the Soviet anti-God campaign. One Soviet evolutionist effort for the "spiritual emancipation" of Russia was recorded in Mr. R. O. G. Urch's Rabbit King of Russia (pp. 82-83). He relates that according to the Krasnaya Gazette of December, 1925, Professor Ilya Ivanovich had left with a scientific expedition on a mission to the Congo. The object was to catch a number of female chimpanzees, and "to fertilise the apes by artificial methods and bring back the mothers with the little human apes to gladden the hearts of the Anti-God Society in Soviet Russia and prove that "There is no God." The result remained obscure, a detailed rumour in circulation in Moscow the next year stating that the ship on which the expedition was returning had been lost with all hands. Evolutionist experiment obstinately refuses to come off, not even to help along the spiritual emancipation of Soviet citizens.

Among the varied offspring of the Darwinian doctrine of man's animal descent are the numerous "scientific" doctrines of free-love. Mr. Gilbert deals at length with these in his useful Evolution: the Root of all Isms. He points out, for example, that the late Professor Freud in his General Introduction to Psychoanalysis, of which teaching he was the founder, lays it down that "man's animal nature is ineradicable" and makes this the justification for "giving full rein to one's sexuality." This Freud affirms to be quite in order as evolution shows that man is "an animal accustomed to the freedom of the jungle." and "unadapted" to the restrictions of Christian civilisation. This is the entire burden of the psychoanalytic gospel. A popular American university textbook, An Outline of Psychoanalysis, edited by J. S. Van Teslaar, states : "Psychoanalysis represents but an extension of the theory of evolution, an application of the principle of evolution . . ." Dr. Samuel D. Schmalhausen, probably America's most popular and persistent champion of the so-called new morality of "sex expression" and "sex experimentation" with unlimited license, bases his arguments throughout on animal behaviour and man's supposed animal descent. "The sexual revolution is the terminal phase of the scientific revolution," he says in his Sex and Civilisation. Robert Briffault, another leading writer on these lines, in a contribution to a symposium by America's "sex philosophers," entitled Our Neurotic Age, records various observations of the habits of monkeys, etc., and triumphantly announces : "No indication is to be found among any animal of an appreciation of the rudiments of Christian morals." Christian morals thus lack evolutionary sanction, and are defined by Briffault as a "disease" of civilisation.

Another by-product of evolution dealt with by Gilbert is Determinism, which teaches that it is wrong to put criminals in gaol

because human beings are not responsible for their actions and have no freewill. Metchnikoff, leading Determinist, in his Nature of Man says : "Evolution knows nothing of free will. All our actions, scientifically speaking, are the necessary outcome of chemical processes of the brain." A number of evolutionists take this stand. Behaviourism goes a step further again, and flatly denies the existence of the soul, of free will, and of consciousness. Its founder, Dr. John B. Watson, started out with a study of animal psychology and then carried on with human psychology. Behaviourism maintains that man is entirely animal, and that "man should be treated just as the animal is treated."

In concluding this brief survey of some of the fruits of the theory of organic evolution, it is interesting to recall the comment of Adam Sedgwick, the geologist, on the Darwinian theory when it first appeared. After reading through his copy of the Origin of Species, the old man sat down and wrote a letter to Darwin on Christmas Eve. 1S59. In it he said :

"We all admit development as a fact of history : but how came it about ? Here in language, and still more in logic, we are point-blank at issue. There is a moral or metaphysical part of nature as weil as a physical. A man who denies this is deep in the mire of folly. 'Tis the crown and glory of organic science that it does through final cause, link material and moral . . . You have ignored this link; and if I mistake not your meaning, you have done your best in one or two pregnant cases to break it. Were it possible (which, thank God, it is not) to break it, humanity, in my mind, would suffer a damage that might brutalise it, and sink the human race into a lower state of degradation than any into which it has fallen since its written records tell us of its history" (Darwin's Life and Letters, ii, 248).

For great masses of people the theory of organic evolution has undoubtedly broken the link between material and moral, has had brutalising results, and has plunged them into a lower state of degradation. It represents lost ground in every direction.

Chapter X

WHAT SCIENCE IS FINDING

NOTHING is more striking in recent scientific literature than the steady accumulation by. evolutionists themselves of a mass of facts wholly opposed to the theory of evolution to which they continue to affirm their adherence. This applies not only in the field of biology, but also, as will be seen in the next chapter, in archaeology and anthropology. In every direction the scientists themselves are busy removing bricks and undermining the walls of the citadel of evolution while at the same time loudly proclaiming the fabric to be intact. The indications are either that the entire theory will presently be abandoned as obsolete and untenable, or, alternatively, that scie'nce will be reduced to the teaching of dogma regardless of fact, in which direction it has already proceeded a considerable distance.

Evolution teaches the mutability of species. Modern scientific observation is becoming increasingly impressed with the great stability of species as the outstanding fact about living organisms. Darwin in concluding the Origin of Species proclaimed that there was no essential difference between varieties and species, species being all the time in process of evolution into new forms, and varieties being merely incipient new species. "We shall at least be freed from the vain search for the undiscovered and undiscoverable essence of the term species," he declared. Living organisms being nothing but a series of dissolving views with everything in transformation, Darwin laid it down that in future naturalists in labelling species would only have to decide whether any form happened to be "sufficiently important to deserve a specific name."

This idea is in line with a notion freely advanced in intellectual quarters today : that there are no pure races of mankind, and that it therefore follows there is no difference between a white man and a negro. On these lines we had Mr. Bernard Shaw holding forth in South Africa a few years back that the uplift of that country would be brought about most quickly by the two million whites intermarrying with the seven million black inhabitants of the country.

On the Darwinian view individuals alone exist in nature, species being purely an arbitrary concept. Nevertheless, species seemed to be sufficiently real to Darwin for him to devote a book of 700 pages to trying to account for their origin. Louis Agassiz, in reviewing

Darwin's book in the American Journal of Science for July, 1860, commented on this anomaly, and asked : "If species do not exist at all, as the supporters of the transmutation theory maintain, how can they vary ? and if individuals alone exist, how can the differences which may be observed among them prove the variability of species ? " It does not appear that Agassiz ever got an answer to this conundrum.

According to evolutionist teaching, living things are a chance product of inorganic matter, and are being continuously pruned and moulded into new shapes by their environment. The living forms are, so to speak, mere jelly or plastic putty, struggling together for existence, in a given environment, and by natural selection attaining an endless succession of forms increasingly adapted to the environment. The environment is the determining factor, and heredity amounts to little or nothing. Such is the grand theory. When the scientists lay their theoretical spectacles aside we find them announcing the exact opposite as the outstanding fact to be observed in the natural world.

Here, for example, is a recent report from the scientific throne, delivered in 1939 by the president of the zoological section of the British Association, Professor James Ritchie, of the University of Edinburgh : "We are accustomed to lay stress upon the variation of living things, upon which evolution depends, but surely more remarkable is the stability of living organisms, which retain their own characters in spite of changes in the environment, and whose germ cells pass these characters unaltered through countless generations" {Nature, September 25, 1939).

As far back as 1921 Professor D. H. Scott was saying exactly the same thing as president of the botanical section of the British Association for that year. He said : "The small variations on which the natural selectionist relied so much, have proved, for the most part, to be merely fluctuations oscillating about a mean, and therefore incapable of giving rise to permanent new types. . . The whole tendency of modern work is" to show that in living things heredity is supreme. An organism is what it is by virtue of the constitution of the germ plasm derived from its parents" (Nature, September 29, 1921).

In the Oxford University Evolution book of 1938, one finds Mr. J. Z. Young, demonstrator in zoology at Oxford, saying (p. 180) : "As Henderson puts it, 'living things preserve or tend to preserve an ideal form, while through them flows a steady stream of energy and matter which is ever changing, yet moulded by life; organised in short.' The very object of our study as biologists is this organisation and its preservation, it is 'the first fact which strikes us about organisms,' and it is, as Woodger remarks, curious that it should be necessary to draw attention to it."—This is tacit admission that evolutionist theory has blinded scientists to what stares them in the face.

Similar testimony to this constancy of species is borne by Professor A. W. Lindsey, of Denison University, U.S.A., in his interest-

ing Problems of Evolution published by Macmillans in 1931. Professor Lindsey remarks that: "All of the selection theories, all ideas of isolation, all of our knowledge of mutations, serve only to show that the characters which make up a species may be reassorted, re-distributed, preserved in part and destroyed in part, or modified to some degree" (p. 134).—In other words, you can get variations within species, and sometimes wide variations, but you cannot get anything whatever which was not there to begin with.

All the above statements are made by professing evolutionists. Nevertheless, all are testimony unfavourable to the theory of evolution. Professor Ritchie after remarking on the stability of species, gets no further than observing that "we must conceive of evolution as a process of extreme slowness." Failure to discover evidence of evolution has led to the scientists making very large drafts on the bank of time. On this point Sir William Bateson remarked a good many years ago that "Time cannot complete that which has not begun."

The majority of the evolutionists did not share this Batesonian view. They felt that evolution could achieve anything if supplied with sufficient time. A furious battle raged in the scientific world from 1892 to 1921 over this subject of time. The geologists, calculating the rate of deposition of the sedimentary rocks, had in the main been willing to supply generous allowances of time. Sir Archibald Geikie on this basis provided evolution with about 100 million years. The physicists next upset the applecart. Lord Kelvin asserted that not more than 40 million years had elapsed since the molten earth solidified. Professor Tait knocked this down to 10 million. Professor Joiy eased the situation by estimating the sodium content of the oceans and the amount of salt carried in by the rivers, and he calculated the age of the oceans as from 80 to 90 million years. Professor Sollas in a British Association presidential address reprinted in his Age of the Earth (1908) affirmed that, properly regarded, both the sedimentary rocks and the oceans testified to about 26 million years as the correct figure : and he asserted that this should be sufficient time for everybody. Most of these estimates were revised by those who made them, sometimes out of recognition.

At the British Association meeting in 1905, Sir George Darwin threw out a life-line to the evolutionists by announcing that Madame Curie's investigations with radium might throw light on the age of the earth. Calculations were thereupon embarked on as to the rate of disintegration of radio-active ores in the rocks, and by 1921 Lord Rayleigh had evolution nicely fixed up with about 1000 million years available for something to evolve into something else. A few more hundred million years have since been thrown in to prevent any undue cramping. Professor Ritchie in his 1939 address was able to remark that "now a concensus of opinion admits credibility to estimates based upon the break-up of radio-active minerals in the rocks," and that they might say life had existed on the earth for perhaps 1200

million years, and that the birth of the sun and stars took place about 2000 million years ago.

Mr. Dewar in his More Difficulties (pp. 101-6) remarks that having abandoned belief in evolution, he has ceased to be particularly interested in the time allowance for the imagined process. He points out that the present fashionable calculation based on radio-activity is in total conflict with all the previous calculations, and seems to have been jumped at on the principle of not looking a gift horse too closely in the mouth. He notes Professor Joly, Mr. D. J. Whitney, and Professor A. Holmes recording the most completely discordant results from tests of radio-active ores obtained from the same rocks. He remarks that the present theory assumes that the rate of disintegration of radio-active ores has always been the same as today; whereas Lord Rutherford, Professor Joly, and Professor Fermi have expressed the opinion that the radio-active elements may be simply the end-product of other elements which disintegrated so rapidly that no trace of them now remains on earth.

Sir Ambrose Fleming, F.R.S., in a presidential address to the Victoria Institute in 1935, said, "It is certain that the geologists have not found any generally agreed and unquestionable test by which to determine the geological age in years of earth crust materials or deposits and the assumptions made by some are disputed by others." Sir Ambrose Fleming has since continued to insist emphatically on the worthlessness of present evolutionist chronology, and he appears to have good grounds for doing so. In every sphere it touches evolution demands the wholesale manufacture of conclusions to fit in with preconceived theory.

Although now supplied with years by the thousand million, the main result seems to be that science finds species remaining unchanged over longer periods than was the case under its former chronology. This stability continues to be the great fact presented both to the zoologist and the botanist. Coupled with it is also another impressive fact, the endless small variations within the species themselves. Species exhibit ail manner of varieties and strains within the interbreeding community, and within these varieties and strains again are endless small individual differences. Here in Nelson, New Zealand, we had the eminent Dutch botanist and evolutionist, Dr. J. P. Lotsy tell us in his Cawthron Lecture in 1927 that: "It is practically impossible to make a group of identical individuals; we can but make a group of similar individuals, because in nature no two in-viduals are alike in all respects." Many other naturalists have made similar remark.

"To my mind," says Mr. Dewar, "one of the most impressive phenomena of the organic world is this variety, coupled with stability of the type. It would seem that in a sense every individual is a new creation" (More Difficulties, p. 72). Mr. Dewar adds that he knows of

no better explanation of this variety than that given by Paley away in 1802 in his Natural Theology (p. 170), when he wrote that what we see around us might "induce us to believe that VARIETY itself, distinct from every other reason, was a motive in the mind of the Creator, or with the agents of His will." In Paley's day not so much was known about this variety in individuals as is now the case. Nobody, for example, had then recognised that apparently the whorls on the finger tips are not alike in any two human beings.

So far from evolution having relieved naturalists of the task of deciding What is a true species and what is not, one finds them still busy discussing the point. In 1938 the Linnaen Society of London celebrated its 150th anniversary with a symposium on "The Concept of Species from the time of Linnaeus to the Present Day." From the London Times report (May 26, 1938) it appears that the speakers were agreed that species area reality, and that a number of them were of the opinion that the true concept of species is an interbreeding community. This, of course, is sliding back a long way from Darwin's idea that in the light of evolution a species is merely a group of similar individuals of sufficient importance to deserve a specific name—a purely arbitrary conception, in short.

As to what are true species—using the word as connoting interbreeding communities—it appears that science today has very limited knowledge. In the Linnean Society discussion Dr. Karl Jordan of the Tring Museum pointed out that a large number of described species are known only from a specimen or two, and great numbers of them are probably mere varieties within other species. In the Oxford University Evoluion book (p. 108) Dr. O. W. Richards remarks that there is only one way to obtain genetical information about species, and that is by breeding experiments. He points out, however, that "many animals are extremely difficult to breed in captivity, and in any case there is no hope that more than a few of the very numerous known species of animals can be investigated genetically."

To a layman it appears curious that with the scientists all at sixes and sevens as to what constitutes a species, they should all be so dogmatic on the origin of species. The cart seems to have got before the horse. Mr. Dewar as an anti-evolutionist and a believer in special creation adopts a more rational attitude. In his More Difficulties (p. 10) he says he does not in the least profess to know what the units of creation are. He does not assert that every species, every genus, or even every family has been specially created. He holds it the duty of biologists to try to discover what these units are. In his opinion the data at present are not nearly adequate to make even a tentative pronouncement; and "all that can be safely said is that so far, breeding experiments seem to indicate that the units of creation are small, or in other words, that the number of these units is great."

It is interesting to note that Professor St. George Mivart in his

Genesis of Species in 1871 quoted various passages from the writings of the early Christian Fathers which showed them as holding it allowable to believe that existing forms of animals and plants are not necessarily the forms of their original creation, but are derived therefrom. Mr. Dewar from his anti-evolutionist point of view says he sees no harm in scientists adopting evolution as alternative hypothesis to creation, but, he adds, "I consider it suicidal to adopt evolution as a creed, to distort facts to cause them to conform to it, to brush aside facts not amenable to it, and to minimise difficulties" (More Difficulties, p. 205).

The task of science is to trace back the chain of causation as far as she can, preceding step by step from fact to fact. The theory of organic evolution is assertion unsupported by evidence, and is an invasion by science of the domain of philosophy and religion. In tracing back causation science must in any case come to a point beyond which she cannot go. Man's rational intellect has its limitations, and is quite incapable of conceiving a First Cause. There are only three possible ideas as to the origin of life : (1) that it was created by external agency, (2) that it has always existed, and (3) that it is the product of spontaneous generation. Modern evolutionist science rejects the idea of creation as "incredible." Major Wren in his Evolution, Fact or Fiction ? quotes various pronouncements on the point. Says Professor J. B. S. Haldane, "The evidence for the existence of a superhuman Designer . . . was invalidated by the discovery of evolution and the theory of Natural Selection" (An Address to Modern Churchmen, Oxford, 1926). Sir Arthur Keith is quoted as stating, "To say that God made matter, and out of dead matter made living matter, cannot satisfy even a child's intelligence, for the child's next question is sure to be, 'and who made God ? ' "

In point of actual fact the constancy of species—which we have noted as impressing itself so strongly on the scientific mind of late— coupled with the endless variety in the individual organisms, is much more consistent with the idea of special creation than with evolution. The observed fact that apparently no two individuals in nature are exactly alike in all respects is in harmony with the intuition of mankind that every living thing is a direct and unique manifestation of the creative power of an omnipotent and omnipresent Deity. When the evolutionist rejects the idea of special creation as "incredible" the most he can say against it is very much what Mr. Dewar in his Man: a Special Creation (p. 95) quotes Dr. S. Zuckerman as saying with respect to human beings :

"Either evolutionary change or miraculous divine intervention lies at the back of human intelligence. The second of these possibilities does not lend itself to scientific examination. It may be the correct explanation, but, from the scientific point of view, it cannot be legitimately resorted to in answer to the problem of man's dominantly successful behaviour until all possibilities of more objective explana-

tion through morphological, physiological and psychological observation and experiment are exhausted" (Functional Activities of Man, Monkeys and Apes, p. 155).

The scientists are not content to adopt a neutral attitude. They are not content to state the plain truth that science has nothing to report about the origin of species, and that the quest for evidence of evolution has run to a dead end with negative results in every direction. They insist on ramming evolution down the public throat, evidence or no evidence. In doing this they cease to be scientists and become theologians. The majority of present-day scientists are atheistically inclined, and evolution provides them with a philosophical background for their atheism. The basic issue is thus not scientific but theological.

When the history of modern evolutionist theory is studied its atheistical basis stands out conspicuously throughout. Any reference book in outlining the history of the theory will be found making reference to Buffon (1707-1788), Erasmus Darwin (1731-1802), Lamarck (1744-1829), and finally Charles Darwin (1809-1882). The Comte de Buffon was a prominent figure among the French philosophers and men of letters inveighing against established religion and providing the ideas which were presently put into practical application in the French Revolution. Guizot in his History of France describes Buffon as "absolutely unshackled by any religious prejudices"; and notes him pulling strings to avoid having his Histoire Naturelle black-listed by the ecclesiastical authorities. An old encyclopaedia (Chambers, 1885) describes him as "largely participating in the vices of the time," and his widow was the last of the numerous mistresses of the Duke of Orleans before that prince was guillotined in the revolution. Buffon put forward evolutionist views, and declared life and mind to be a property of matter.

Lamarck's religious views are not mentioned in any reference book at hand, but he was under Buffon's patronage and was tutor Xo Buffon's son for a number of years, and presumably found the atmosphere of the household to his taste. Alison's History of Europe (i, 176-7) states : "Almost the whole of the philosophical and literary writers in Paris, for a quarter of a century before the French Revolution broke out, were avowed infidels; the grand object of all their efforts was to load religion with obloquy, or, what was more efficacious in France, to turn it into ridicule. When David Hume was invited at Paris to meet a party of eighteen of the most celebrated men in the French capital, he found, to his astonishment, that he was the least sceptical of the party : he was the only one present who admitted even the probability of the existence of a Supreme Being." It does not appear whether Buffon was of this company, but he ornamented many such gatherings.

Erasmus Darwin, grandfather of Charles Darwin, aired evolutionary views in his Zoonomia published in 1794. He was a physician at Derby and became acquainted with Rousseau during the period

when the latter was living in exile in England at Lichfield under the patronage of David Hume, and corresponded with him thereafter. Rousseau was the chief philosopher of the French Revolution, affirming that man was born innocent and good, that the savage was the model of every virtue, and that all miseries and vices were due to the tyranny of kings, the deceptions of priests, the oppressions of nobles, and the evils of civilisation. Property, he declared, was the great evil which had ruined mankind : and self-control was a violation of nature. It was significant of much that was to come that Rousseau opened his famous Discourse on the Origin of Inequality by saying, "Let us begin by laying facts aside as they do not affect the question."

Charles Darwin in his Life and Letters (iii, 179) describes his father, son of Erasmus, as "a freethinker in religious matters," and although he himself was at one time a divinity student at Cambridge, he presently turned his back on both the Church and Christianity. It is noticeable that both Darwin and Huxley abandoned their religious beliefs at or about the time at which they adopted evolutionist views.

Darwin derived the basic idea of his theory—the struggle for existence—from Malthus, and it is curious that although Malthus himself was a clergyman of the Church of England, his father, Daniel Malthus, according to Beale's Racial Decay (p. 38) was a friend and executor of Rousseau. If Buckle's statement in his History of Civilisation is correct, and Voltaire was the real originator of the Malthusian idea of population increasing faster than food supply, we have yet another root of modern biological science running back into the midst of French pre-revolutionary philosophy. "Voltaire," says Guizot's History of France, "has remained the true representative of the mocking and stone-flinging phase of free-thinking ... At the outcome of the bloody slough of the French Revolution and from the chaos it caused in men's souls, it was the infidelity of Voltaire which remained at the bottom of the scepticism and moral disorder of the France of our day" (Sampson Low's edition, 1889, p. 521).

The foregoing facts are sufficient evidence of a pronounced atheistical background in the incubation of the theory of organic evolution. It is obvious that if belief in God is rejected, a necessity at once arises for some theory accounting for the origin of life otherwise than by creation from the dust of the earth. Evolution meets this need, and the indications throughout are that evolution is a theological and not a scientific product. It was invented to meet the requirements of atheism, and it is maintained and propagated for the same reason.

Chapter XI

MAN AND CIVILISATION

THAT expensive compendium of evolutionary fairy stories, the fourteenth edition of the Encyclopaedia Britannica, opens its article on civilisation with the announcement that "there could be no real understanding of the fundamental characteristics of civilisation until the fact was well established and digested that if we could trace back man's lineage far enough we should find it merging into that of wild animals." The truth of the matter is that modern research into the origins of civilisation and human culture is busy all the time piling up a mass of facts totally inconsistent with any such evolutionist ideas.

The archaeologists excavating in Babylonia and Egypt report that they are unable to discover any beginnings to civilisation. As far back as they can go man is already civilised. At the same time the diffusionist school of anthropologists which has grown up in the past twenty years reports that the weight of evidence is that no savage race ever invented anything, and that all culture was diffused from a common source in South-western Asia, with its centre somewhere about the head of the Persian Gulf.

On page 71 above we noted the late Professor A. H. Sayce remarking on this failure of archaeology to discover any beginnings to civilisation, and asking whether the truth was that the Bible was right after all, and man was civilised from the beginning. In quoting this passage in his book Dr. Bell Dawson did not mention its source, but it is possibly from the Huxley Lecture of 1930 on "The Antiquity of Civilised Man" which Professor Sayce delivered to the Royal Anthropological Society, and of which an abridged report appears in Nature of November 29, 1930. In that report one finds Professor Sayce remarking incidentally that the jewellery discovered in the remains of the earliest civilisation would grace a Bond Street jeweller's window today. When the present writer, in common with the many other New Zealand soldiers of the last war, visited the Cairo Museum, nothing impressed him more than the beautiful workmanship of the jewellery of the First Dynasty, dating back to a period almost as far before Moses as we are after him.

Writing of the earliest remains of pre-dynastic civilisation in Egypt, Mr. Arthur Weigall, formerly inspector-general of antiquities

to the Egyptian Government, says in his Short History of Ancient Egypt (1934, p. 19) : ". . . We find ourselves confronted with a civilisation in being and we really do not know whence it came. Writing had begun; the arts were already highly developed; great armies were in commission; cities had grown up; and the king was surrounded by his ministers and his nobles." Other archaeologists make similar report as to the. absence of any discoverable primitive beginnings to these ancient civilisations.

Turning to the side of anthropology, we find a recent writer of the diffusionist school, Lord Raglan, who was president of the anthropological section of the British Association in 1933, providing considerable further food for thought. In his How Came Civilisation ? (1939, pp. 56-7) he states that all the evidence is that the inventions and discoveries on which European civilisation—that is to say, Graeco-Roman civilisation—was based, seem to have been made somewhere within a region centering on Persia and extending from Egypt to North India and China. "The question then arises," adds Lord Raglan, "were the people of Persia, Mesopotamia, etc., when they began to make all these discoveries and invent all these traits, savages ? The answer must be that if they were they must have been very different from any savages, either ancient or modern, of whom we know anything, since these latter, as we must repeat, are not known ever to have invented or discovered anything."

Current belief today is that the savage races of the world are in the same state civilised man is supposed to have been in a few thousand years ago, and if left alone would ultimately rise to civilised status by process of gradual "evolution." Lord Raglan in summing up the diffusionist case in his most interesting little book, says all the evidence is in exactly the opposite direction, and that "no savage society, when left to itself, has ever made the slightest progress." The only change that has ever been observed to take place in these isolated societies is a change for the worse.

Many lands are stated by Lord Raglan to provide evidence of this retrogression, and it is especially evident in Polynesia. Language and customs show that the people of the Pacific Islands from Hawaii to Easter Island and across to New Zealand probably spread from some common centre. They possess sea-going canoes, but since they have been known to Europeans they have never ventured far out of sight of land. Their ancestors must have made long voyages again and again. In many of the islands are erections built of large blocks of stone. The modern Polynesian is completely ignorant of the art of building in stone. Dixon in his Building of Cultures (p. 280) says that "the Polynesians in their eastward drift into the Pacific lost textiles, pottery, and metal-working, and gave up the use of the bow." Fragments of pottery are found scattered about on islands where the natives have now lost the art. In the New Hebrides the natives had the art of weaving in the seventeenth century, but have since lost it. Lord

Raglan devotes a chapter to instances of deterioration of culture among different savage races, and says that so far as he can learn there is nothing whatever to put into the scale against it. Savage races are capable of being civilised by missionary effort, but are incapable of civilising themselves.

Taking such items as the bow and arrow, the domestication of animals, the plough and the hoe, pottery and the potter's wheel, etc., Lord Raglan contends that all the evidence points to diffusion of these inventions and discoveries from a common centre. "I know of no case," he says, "in which anything which can be described as an invention has been recorded as having been made by a living savage . . . People who themselves have never had an idea exhibiting the slightest sign of originality have no difficulty in crediting primitives or savages with brains of the utmost fertility. . . what have Binks the banker and Brown the bus-driver invented ? There are in our midst thousands of intelligent and capable Binkses and Browns who have invented nothing whatever; can it really be believed that every savage community, however small and primitive, has produced a succession of men possessing an inventive genius such as has been totally denied to Binks and Brown? " (pp. 40-1).

Throughout historic times we know that civilisation has spread by diffusion. On what ground, asks Lord Raglan, are we to assume that in pre-historic times the exact opposite was the case and everything was independently invented? Everything points to things like the baking and glazing of pottery, the use of the potter's wheel, etc.,. etc., only being discovered once. The distribution of culture points to groups of people pushing out in all directions from the original home of mankind. The larger the cultural equipment in such a movement, the further it would be likely to get, and adaptation to the environment would probably consist of dropping whatever elements were unsuitable to life in the wilderness. On top of this, as families possessing skill in various crafts became extinct further cultural loss would be probable. In another striking passage Lord Raglan says :

"We know that our own civilisation in all but its latest phases, was not evolved locally, but derived from the Mediterranean. We know that Greece derived its civilisation from Asia Minor, Crete and Egypt. We, like the Greeks and Romans, have improved upon the civilisation which we received from outside, but it is quite untrue to say we evolved our own civilisation. It is then clearly not the fact that civilisation has everywhere been evolved out of savagery, and to say that it has anywhere been evolved out of savagery is a guess which cannot be supported by any evidence. As Niebuhr (quoted by Tylor, Primitive Culture, i. 41) remarked, 'no single example can be brought forward of an actually savage people having independently become civilised.' So far as we know, all civilisation has been derived from pre-existing civilisation, not from savagery.

"Of the real beginnings of culture we know nothing for certain, and it is very doubtful whether we ever shall. It seems likely that the cradle-land of the human race was in South-western Asia, where was also the seat of the earliest civilisations, yet there are fewer traces of 'primitive man' there than in many other parts of the world. Whether this is because the earliest cultures are beneath the silt of the Euphrates or the Indus, or whether their remains still await the chance disturbance of the surface at some hitherto unsuspected spot we cannot say. What we can say is that all the facts alleged as the beginnings of culture are fallacious" (pp. 50-1).

It is impossible to present here even an outline of the evidence on which the diffusionist anthropologists reach their conclusions. Lord Raglan's intensely interesting little book so freely drawn upon above, gives the most recent outline of the case; and the reader desiring more information will find it in the books of Dr. W. J. Perry and the late Sir Grafton Elliot Smith, formerly professor of anatomy in the University of London, who appear to have been the leading exponents of this line of research. It may be mentioned in passing that the diffusionist contention is that the Maya and Inca civilisation of America was carried from East Asia by sea-voyagers across the Pacific. Like the ancient civilisations of the Near East, this appears to have no primitive beginnings; and the diffusionsts point to many remarkable affinities with Asiatic civilisation.

Coupled with the inability of the archaeologists to uncover any primitive origins of the Mesopotamian and Egyptian civilisations, the evidence assembled by the diffusionist anthropologists presents believers in human evolution with some very considerable nuts to crack. Curiously enough, the diffusionists themselves are all convinced evolutionists. The late Professor Elliot Smith ranked as a leading authority on monkey-men. Lord Raglan in his book says on page 56 that "we may suppose that man v/as evolved from the ape within this region" of ancient culture. Dr. Perry in his Growth of Civilisation (1924) on page 112 reveals himself as an evolutionist also. His view is that through a misunderstanding of evolutionary doctrine it has been assumed that simple forms of social organism must necessarily have preceded the more advanced in all parts of the world. Both he and Professor Elliot Smith claim in their books that Egypt provides evidence of a development of civilisation from primitive beginnings. The archaeologists, however, appear unable to find evidence either there or anywhere else of the origins of any of the ancient civilisations.

Accepting evolution in general, the diffusionists reject all idea of evolution as an operating principle in human society. We have seen the flimsy and worthless evidence which is supposed to show mankind as descended from brute beasts. On top of this the archaeologists are unable to find any trace of civilised man ascending from barbarism. Finally, to crown all, the diffusionist anthropologists pre-

sent a mass of facts all pointing to the diffusion of culture throughout the world from some common centre. They may overstate their evidence in some respects, but they certainly assemble together enough to make an exceedingly strong prima facie case against the idea of any upward evolutionary movement from barbarism to civilisation. The net result is complete demolition of any idea whatsoever of evolution in mankind and human affairs. In view of all the facts the following from Mr. Dewar's Man: a Special Creation (p. 28) is to the point :

"We have no reason for supposing that ... the mental powers of the prehistoric men known to us were lower than those of their descendants; in these early races of man, to quote Professor W. Schmidt (European Civilisation, 1934, p. 76) : 'No "ape-like" features are to be found. On the contrary, their really human character manifests itself with purity, clearness and beauty, as certainly as anywhere else in the whole history of mankind . . . Thus, once and for all, we may finally abandon any expectation of fresh evolutionary links being established between the spiritual life of man and that of the highest forms of animal life. Even in the earliest representatives of mankind known to us, the soul is so absolutely and completely human that the advance to it from the highest level of the brute creation is more plainly than ever seen to be an impossibility, and mental development such as evolution requires it utterly excluded.' "

Lord Raglan points out that except for the complex known as Western civilisation, all the cultures of the world today are in a state of decay and degeneration. Civilisation, he says in concluding his book, is far from being a process which keeps going on everywhere. It is really an event which has only occurred twice on the grand scale. All the evidence suggests that the first time was somewhere in Southwestern Asia about the fourth millenium B.C., at which time a number of discoveries were made—corn-growing, cattle-breeding, metal-working, pottery, the wheel, the sail, the loom, the brick—which discoveries were diffused in varying degree about the world. This civilisation reached its prime, and then stagnated and decayed, finally collapsing with the fall of the Roman Empire, the Romans themselves inventing practically nothing.

After a thousand-year interval a new burst of enterprise and inventiveness came, and our present Western civilisation began to arise. "Our Western civilisation," says Lord Raglan, "is not a product of evolution or any other natural process, but the result of a series of historical coincidences" (p. 181). In 1400 Europe knew very little that had not been known in Babylon, Egypt, Greece and Rome. In the fifteenth century four very important events occurred. The Turks took Constantinople, and the dispersion of the scholars of the Byzantine Empire flooded Europe with classical knowledge; America was discovered and a new world opened up; block printing was introduced from China; and a ferment of religious thought accompanied the rise of Protestantism. The upshot of these happenings was a

stirring among mankind which has continued to our day, with steam, electricity, and all manner of inventions transforming life throughout the world. How the first civilisation arose we do not know; but Lord Raglan points out that it was religious in its inspiration, whereas the second was mainly secular. Other writers, however, dwell on the fact that learning was preserved through the Dark Ages in the monasteries and by survival to the fifteenth century of the Christian Byzantine Empire; that the synods of the Church provided the pattern on which the representative political institutions of Europe were modelled; and that the Christian tradition gave Europe a totally different civilisation from the despotisms of Asia, all kingly power being viewed under it as held in stewardship from God.

The diffusionist anthropologists, as already remarked, are evolutionists who flatly reject evolution as a factor in human affairs. Evolution apparently operates throughout the rest of nature, turns apes into men, and then suddenly ceases to operate for reasons not explained. The diffusionist literature is unsatisfactory in that fact and speculation are as badly mixed up as in the rest of present-day scientific literature, and it is not always easy for the lay reader to discover where one ends and the other begins. The diffusionists are orthodox scientifically in their views in so far that evolution is evolution up to man's appearance, and religion is apparently superstition wherever appearing. Nevertheless, the actual facts they present as to diffusion of culture from a common centre are numerous, striking, and destructive of belief in human evolution.

The late Sir Grafton Elliot Smith in his Human History (1934 edition, pp. 59-60) is even more emphatic than Lord Raglan in his rejection of evolution as a factor in human affairs. The idea that human destiny is under control of the terrestrial forces of nature he regards as a mistaken and fallacious application of science to history. He protests strongly against the almost mystical significance given by some writers to climate and geographical environment as implying "some inevitable process of mechanically working development leading to inevitable results in shaping human qualities and behaviour." History, he says, is cataclysmic, and he quotes with high approval an article to this effect by Sir Charles Oman, former professor of modern history at Oxford, in the National Review for February, 1929.

In the history department at Oxford University the student under Professor Oman apparently had to leave his evolutionist ideas outside on the doormat for the time being. Professor Oman is quoted as saying : "Two generations have now passed since the blessed word 'Evolution' was invented, and was applied as a universal panacea for all the problems of the universe—historical no less than physical or metaphysical. By this I mean that a whole school of historians have set forth the thesis that history is a continuous logical process, a series of inevitable results following on well-marshalled tables of causes." Sir Charles Oman will have none of this. The career of mankind, he

says, has been shaped by accidents and catastrophes and by the action of dominating personalities who have deliberately provoked great movements, peaceful and warlike, which have shaped the destiny of the world.

"The great events in Human History," says Professor Elliot Smith, "were provoked by individual human beings exercising their wills to change the direction of human thought and action, or by natural catastrophes forcing men of insight to embark on new enterprises." He points out that, according to Sir Charles Oman, America would have been colonised by the Norse inhabitants of Greenland if the Black Death in 1350 had not completely destroyed these people. Eventually, the irruption of the Turks into Europe blocked the old trade routes to Asia, and led to search for a new route to the Indies. These historical incidents provided the predisposing causes for a momentous event. But it was the vision and persistence of Columbus which effected the transformation.

The importance of the individual is similarly stressed by Lord Raglan in his How Came Civilisation? (p. 172). "Sentimentalists," he says, "may imagine that new culture forms arise from the 'communal mind' or the 'spirit of the folk' or some such abstraction, but the fact is that new ideas can only occur to individuals and do only occur to highly exceptional individuals." Lord Raglan incidentally remarks that it is often assumed that decay is due to conservatism. But decay can occur in other ways than by standing still or going backward. "It is often less realised on the other hand," he adds (p. 172), "that decay of culture can be brought about even more rapidly by breaking away from the past; by the belief that we could and should go back to nature, shaking off the burden of tradition and all that it entails, and living and developing in the innocent freedom of primitive man. People who think like this fail to realise that man became man by getting away from nature, and that it is unnatural not merely to cook food and wear clothes, but to read and write, and even to speak. We learn these arts not from nature, but from tradition. The belief that primitive man was wiser and better than we are is really a symptom of degeneration, of 'that degeneration of the democratic theory which imagines that there is a peculiar inspiration in the opinions of the ignorant' (John Buchan, Augustus, p. 340)."

An outstanding feature of the diffusionist argument is the emphasis placed on individual enterprise and initiative as the source and mainspring of civilisation. Equally outstanding is the disregard of the individual in the evolutionist interpretation of history, of which interpretation the Marxian socialist materialist view of history is an offshoot. The dominant idea of evolutionist philosophy as applied to sociology and history is the insignificance of the individual as compared with society past and present. In his Critical Examination of Socialism (1909, chap. viii) w. H. Mallock discussed this point at length. He remarks that the modern socialists did not originate this leading idea of

theirs, but borrowed it from the evolutionists, among whom Herbert Spencer was its most systematic exponent.

Herbert Spencer in his Study of Sociology (p. 35) lays it down that the great man is only the "proximate originator" of changes, and that the real explanation of these changes must be sought in the "aggregate of conditions" in which he exists. Mallock points out that Macaulay in his essay on Dryden said the same thing : " it is the age that makes the man, not the man that makes the age." This idea was the mainstay also of Buckle's History of Civilisation. Edward Bellamy in his Looking Backwards, a description of a socialist Utopia which had an enormous sale half a century back, likewise asserted that "nine hundred and ninety-nine parts of the thousand of the produce of every man are the result of his social inheritance and environment." Herbert Spencer in his book quoted goes at length into demonstrating that the inventor of a new printing press just installed by the London Times was no more than its "proximate initiator," and that the press was really produced by the "aggregate conditions" of the period. This aggregate of conditions similarly produced Shakespeare's plays.

Benjamin Kidd, a semi-socialist, is noted by Mallock as helping along the good work by pointing out that various inventions have been arrived at almost simultaneously, and "thus rival and independent claims have been made for the discovery of the differential calculus, the invention of the steam-engine, the methods of spectrum analysis, the telephone, the telegraph, as well as many other discoveries." It is thus inferred that almost anybody might make these discoveries. Mr. Mallock remarks that actually the position with many inventions is that a number of men are trying to scale a peak at the same time, and it is not surprising that two or three men of exceptional ability should sometimes simultaneously reach the previously virgin summit. That anybody might have made the invention is no more demonstrated by this happening than an ascent of the Matterhorn demonstrates that all the people in the tourist hotel at the bottom could have made it. Yet this is the burden all the time of the evolutionist-socialist song—the individual is nothing, environment is everything.

Mankind is viewed in the mass in these theories. But when anything practical is needed in life it is the individual man that counts. The patient at death's door is not helped by being told that man is a great physician and having the first passer-by taken in to attend to him. A series of great frescoes to adorn a public building is not secured by information from the sociological department that great artists are the product of the aggregate of conditions : millions of men subject to this aggregate of conditions might be taken off the streets and tried in turn, and nothing result but hopeless daubs.

The point to which the evolutionist-socialist argument is directed is to show the smallness of the products which the able man can really claim as his own. Another point that it seeks to make is the common-

ness of ability, which is regarded as purely a product of the environment. Furthermore, whether the great man is a rare or a common phenomenon, his inventions and discoveries become common property. Mallock observed Mr. Sidney Webb (now Lord Passfield, the pope of the Fabian socialists) giving a practical turn to the argument. He noted Mr. Webb, discussing the question of equal pay for all, and holding that the able man has no moral right to a greater share of the product of labour than the less able worker. If one man's brains and effort are responsible for nine-tenths of the value produced, and the other man's one-tenth, they are thus each entitled to fifty per cent. Mr. Webb is quoted as saying that this proposal "has an abstract justification, as the special energy and ability with which some persons are born is an unearned increment due to the effect of the struggle for existence upon their ancestors, and consequently, having been produced by society, is as much due to society as the unearned increment of rent."

Such is evolutionist-socialist philosophy applied to economic affairs. Mr. Webb's notion is not the aberration of a person of no account. It is the idea of one of the most influential socialists in the British Empire. The same idea forms the entire theme of a big book written by another eminent socialist, Mr. G. Bernard Shaw. In his Intelligent Woman's Guide to Socialism and Capitalism (1928), Mr. Shaw says equality of income is the basis of socialism, and on page 341 he says, "when there is a difference between the business ability of one person and another, the price of that difference is rent," and this "rent" must be "nationalised" by equal pay for all. Duffers and loafers under socialism are thus entitled to more than they produce : able and energetic workers, on the other hand, have no moral claim to the larger or superior produce of their labour, which is an unearned increment due to accidental effects of evolution and belongs not to them but to society. On this basis the idle man owes his idleness to society, the stupid man his stupidity, and the dishonest man his dishonesty. Nobody is responsible for anything, and all connection between conduct and the natural results of it is brought to an end.

Evolutionist emphasis on the environment as the controlling factor in the living world has long coloured political thought, and particularly socialist thought. Ability is assumed to be evenly distributed throughout the community and ready to spring forth in all directions with improved environment. When we turn to the actual facts as to the occurrence of ability, we find a different story. A handy summary of the results of various lines of investigation into the subject is Mr. Eldon Moore's Heredity Mainly Human (1934). Mr. Moore, on one side, reviews the facts revealed as to the distribution of ability by intelligence tests of school children. These tests are designed to discover the actual intelligence of the individual as measured by the time taken to solve various ingeniously devised problems. At the other end are various enquiries into the occurrence of exceptional ability,

based on examination of the biographies of great men of history, etc.

The intelligence tests, according to Moore and Professor Terman, show that about three-quarters of the children tested are bunched together within 15 per cent. of the average, above and below; and that a third of the total tested come within 5 per cent. of average intelligence either way. About one in ten ranges from 15 to 25 per cent. above average intelligence, and no more than two or three individuals in a hundred have intelligence in excess of this. So far as they go, these tests thus suggest that the community is not supplied with vast concealed reserves of surplus ability. A further fact revealed by the tests is that, taken generally, the intelligence of the children corresponds closely to the occupational and social status of the parents. On top of this, tests of children reared under identical conditions in orphanages, etc., and many of whom have never known their parents, are stated by Mr. Moore to show just the same distribution of intelligence according to the occupational status of the parents as do home-reared children. This indicates that heredity and not environment is the dominating factor, and that what the scientists have noted about living organisms generally applies with equal force to human beings. It further indicates that whatever its other defects, the social and economic organisation under which we have lived has been efficient on the whole in allowing ability to find its level.

Turning now to the inquiries into the occurrence of exceptional ability, we find Mr. Moore's analysis of a number of different investigations showing that exceptional ability runs very largely indeed in strains. For example, one of the first of these investigators, Sir Francis Galton, in his Hereditary Genius (1869) made a list of 451 greatest men of all time in eight different fields of endeavour. He then discovered that these 451 men had sprung from a mere 300 families, which families had produced a further 562 men of eminence. Nearly a third of the 451 greatest men had eminent fathers, whereas only about one person in four thousand in the general population had a father reaching the degree of eminence adopted in the inquiry.

Another inquiry, made by Gunn, selected from the thirty thousand biographies of the British Dictionary of National Biography some 200 greatest men in the period from 1500 to 1900. Of these 200 greatest men, 21.5 per cent. had fathers with biographies also in the Dictionary, 30 per cent. had brothers, and 64 per cent had sons. Only 31.5 per cent. had no such kin with dictionary biographies. In some walks of life family influence of course, can do much in helping mediocrity along to prominence. Family influence, however, cannot make a man into a great or even eminent poet, artist, musician, philosopher, or scientist, and Mr. Moore notes that the great men in these spheres had just as many eminent relatives as had those in such careers as the law, the army, public life, etc., where influence could operate.

Both lines of investigation as to the occurrence of ability in human beings thus demonstrate heredity as the dominating factor. On top of this Mr. Moore in his book (p. 204) notes another influence co-operating to marked extent. He remarks that "artists, musicians, scientists, and poets beat their illustrious brethren hollow in the number of eminent sons; and they are the men whose gifts are most individual, who live and work at home, and make the closest contact with their children. A pedigree examination which cannot be reduced to figures, further confirms me in concluding that the one environmental circumstance of material importance in these highest grades of achievement is—Family Tradition."

Both lines of investigation are in complete harmony with the report of the scientists that a living organism is what it is by virtue of the germ plasm inherited from its parents. Added to this we have the mass of matter the diffusionist anthropologists have been assembling, all pointing to civilisation as founded on the discoveries and initiative of a very small number of exceptional men. The inference is that a social and economic organisation which gives free play to initiative and ability wherever found is the type of organisation which is likely to result in the highest civilisation. Evolutionist philosophy as applied to politics has tended to exactly opposite conclusions, and is the basis of present-day ideas of a completely controlled economy with everything regimented from above, and with little or no room for initiative from below.

As like tends to produce like, and the different kinds of degrees of ability run largely in strains, it follows that a social organisation under which the son slips easily and naturally into his father's place is one most likely to have the highest degree of efficiency and stability —provided that at the same time the organisation has sufficient flexibility to enable exceptional ability at all times to push through to its level. Furthermore, what Mr. Moore remarks about the influence of family tradition applies much more widely than to artists, musicians, and the like. It suggests strongly that the family business undertaking with son succeeding father is likely to be about the best type of undertaking with highest traditions and efficiency. Under present-day ideas this type of business appears to have been specially selected by those in authority for extinction. The existing financial system has tended for a long time to entrap such undertakings into debt and then hand over their mangled remains for incorporation in some financier-controlled combine. Planning and control ideas further accelerate the process.

Summed up, the indications are that the application of political programmes based on evolutionist philosophy is more likely to plunge our civilisation into the stagnation and decay in which every other civilisation has sunk than to lift it to higher levels. In this, as in every sphere it touches, the false theory of evolution is potently at work as an agent of disintegration.

Chapter XII

CONCLUSION

SIX years ago a small group of scientific men and others launched an Evolution Protest Movement in London. In a circular they issued it was pointed out that subversive doctrines were undermining every side of national life, and that this pointed to some fundamental fallacy operating on the national mind as a whole. This fallacy they believed to be the acceptance as true of the theory of evolution and its employment as the spring of action in all spheres. The reader is now in possession of the necessary material for forming his own opinion as to the soundness of this contention. He has viewed the small substratum of fact on which this top-heavy theory has been erected. He has also traced the peculiar origins of the theory : has seen how observed facts on which scientists are now dwelling run in flattest contradiction of it: and has glanced briefly over some of its principal fruits in the spheres of theology, morals, politics and economics.

The outstanding fact about the evolution theory is that it was a revival in the middle of the nineteenth century of ideas which had formed part of the intellectual ferment leading to the French Revolution. The propagation of evolution in the universities of Britain and elsewhere has been accompanied by an exactly similar growth of atheistical and revolutionary thought to that preceding the upheaval in France a century and a half ago. The weight of evidence throughout as we have seen, is that evolution is a theological and not a scientific product. If belief in God is rejected it becomes necessary to provide some theory as to the origin of life. The theory thus provided is next bolstered up with such material as can be scraped together, in great part by reckless distortion of observed fact, and then in turn becomes the means of further propagation of atheism. The result is that immense numbers of people are swung adrift from their bearings, social tradition is weakened, and upon one set of false assumptions an endless series of further false assumptions is erected in every direction. The entire theory and its offspring are products of the forces of darkness and not of light.

Modern evolutionist thought without doubt had its birthplace in the atheistical and revolutionary philosophy of eighteenth century France. Nothing is more mistaken than to regard the French Revolution as the spontaneous uprising of an oppressed people. All the

evidence points to its having been a most carefully prepared event by men of great, though diabolical, intelligence in whose hands the mob were mere pawns. One of the greatest historians of the nineteenth century was Lord Acton, and he wrote of the French Revolution: "The appalling thing is not the tumult but the design. Through all the smoke and fire we perceive evidence of calculating organisation. The managers remain studiously concealed and masked, but there is no doubt about their presence from the first" (vide. The Cause of World Unrest).

Many writers, such as Mrs. Nesta Webster in her World Revolution, and the London Morning Post in its book of reprinted articles of 1920, The Cause of World Unrest, have gone into the nature of the hidden forces behind the French Revolution and other revolutions. The indications are that there has existed down through the centuries from ancient days a body of thought opposed to the whole World Order, and from time to time inspiring bloody upheaval. In its broadest aspects the subject was discussed by Professor Gilbert Murray of Oxford in his essay on Satanism and the World Order published in 1920. Professor Murray pointed out that both by thinkers and writers of pagan Greece and later on by those of Christendom the belief has been held that there exists a Cosmos or Divine Order : that what is good is in harmony with this Order, and what is bad is in discord against it. Opposed to this, there has also existed a belief that the World Order is evil and a lie. After noting that an appalling literature of hatred is in existence, dating at least from the eighth century B.C., Professor Murray added : "The spirit I have called Satanism, the spirit of unmixed hatred towards the existing World Order, the spirit which rejoices in any great disaster to the world's rulers, is perhaps more rife today than it has been for a thousand years. It is felt to some extent against all ordered Governments, but chiefly against all imperial Governments, and is directed more widely and intensely against Great Britain than against any other power."

This idea is exactly that which the late Lord Sydenham, a former Governor of various parts of the Empire, expressed in his autobiography My Working Life published in 1927 : "That the main bulwark of law and order and of Christianity should be laid low by any and every means is, therefore, the main object to which all revolutionary forces are now directed. The rest would be easy. The Union Jack is the most formidable enemy of the Red Flag."

A remarkable book first published in 1935 takes the view that the basic conflict in the world is between Supernaturalism, in which all power and authority is viewed as derived from God on high, and Naturalism, in which all power is viewed as derived from man below. The latter view leads to deification of man, which was the essence of the revolutionary philosophy of Rousseau : and under it no eternal principles of right and wrong exist, and murder—for example—ceases to be a crime if a victorious majority at an election so decrees. This

book, The Mystical Body of Christ in the Modern World by the Rev. Dr. Denis Fahey, professor of philosophy and Church history at Blackrock College, Dublin, points out that having rejected Christ, the Supernatural Messias, the Jews thereafter looked forward to a Natural Messias and the establishment of a World Order under the Jewish nation. In this author's view all who do not fully accept the Supernatural Messias are inevitably drawn, consciously or unconsciously, into the army which is working for the advent of the Natural Messias. This line of thought is similar to the idea expressed by a Jewish author, Mr. Magnus Hermansson, who in his book, Where Now, Little Jew ? contends that the Jewish question will only be solved by both Jews and Christians adopting Christianity, a view which was not shared by the American Hebrew of May 20, 1938, in recommending both Jew and non-Jew to read Mr. Hermansson's book. This again takes us back to Lord Bryce's diagnosis that the trouble with the world is that the nations have professed Christianity without practising it.

It is at least certain that the revolutionary upheavals have not made the world a better place to live in. Dr. Fahey in his book (p. xxi) quotes a spokesman at the Assembly of the French Grand Orient in 1920 as saying: "Every revolution had for object to bring about universal happiness. When our ancestors proclaimed the principle of Liberty, Equality, and Fraternity, they aimed at realising this state of happiness. After one hundred and thirty years we see the result of their efforts, and they are not famous. Of Liberty, there is not a shred left; of Equality, there is scarcely a trace; of Fraternity, there has never been a sign."

It has been remarked that any human society will always and inevitably form itself into the shape of a pyramid, and that if the pyramid is overturned the units in the human ant-hill will immediately and necessarily build up another pyramid without a moment's delay in order to preserve their social existence. All that the people ever get out of a revolution is a change of masters. They may exchange a Tsar for a Stalin and an aristocracy of nobles for an overlordship of Bolshevik commissars, but they will never escape from the pyramidal organisation of their social machinery.

This point was discussed by Nicholas Berdyaev in his essays on The Russian Revolution (1931). The author was an eye-witness of the Russian Revolution up to 1922 as a Professor in the University of Moscow, but then abjured Bolshevism and all its works and went into exile. He points out that atheistic communism is Christianity turned inside out, and either Christians must put their Christianity into practice or see the world reorganised in the name of a godless collectivity. Christianity, he says, is the only basis on which a solution can be found for the painful conflict between personality and society, which communism resolves in favour of society completely crushing out personality. "And," Berdyaev adds, "it is also the only basis on which a solution can be found for the no less painful conflict between the

aristocratic and democratic principles in culture, resolved by communism in favour of completely overthrowing the aristocratic principle. On a basis of irreligion, either aristocracy oppresses and exploits democracy, or democracy vulgarises the souls of men, lowers the cultural level, and destroys nobility."

"Good which does not work itself into life, which has turned into conventional rhetoric so as to hide actual evil and injustice," says Berdyaev, "cannot avoid raising revolt, and righteous revolt, against its own self. The Christians of our bourgeois epoch of history have created most painful associations in the minds of the working class; they have not done Christ's mission to the souls of the oppressed and exploited . . . The situation of the Christian world face to face with communism is not merely that of the depositary of eternal and absolute truth, but also that of a guilty world which has not practised the truth it possesses, but rather turned traitor to it. Communists practise their truth and can always oppose that fact to Christians. Of course, Christian truth is much harder to carry out than communist truth. Much more, not less, is demanded of Christians than of communists, of materialists. And if Christians carry out less, and not more, Christian truth itself is not to blame." In Berdyaev's view, either the world must be renewed "in the name of God and Christ, of the spiritual principle in man, or in the name of divinised matter, in the name of a divinised human collectivity, in which the very image of man disappears and the human soul expires."

An enormous background lies behind the theory of organic evolution, our present subject. It has been noted that when Darwin published his Origin of Species he had apparently by no means fully convinced himself of its soundness. The fact of the matter is that after reflecting on the subject for over twenty years Darwin finally rushed into print in order to avoid being forestalled. Once his book had appeared and been acclaimed he cast all doubt aside and upheld his theory. Before publication all was uncertainty in his mind. For instance, in 1856 one finds him writing thus to his closest friend, Hooker, the botanist: "It is a melancholy, and I hope not quite true view of yours that facts will prove anything ... I do not fear being tied down to error, i.e., I feel I should give up anything false published in the [proposed] preliminary essay, in my larger work; but I may thus, it is very true, do mischief by spreading error, which I have often heard you say is much easier spread than corrected" (Darwin's Life and Letters, ii, 70).

Recent events remind us that in the public schools of New Zealand evolution and Christianity are very differently regarded. In bygone years a number of leading atheists, some of whom came to occupy high positions, took advantage of the dissensions of the Christian sects cleverly to engineer a movement to de-Christianise the schools as a step to universal de-Christianisation.

In October, 1940, the newspapers recorded the Director of Education as officially notifying the "Wellington Education Board that its decision to open the schools in its district by recital of the Lord's Prayer was entirely unlawful and of no effect. The Board, however, was reported as adhering to its decision. Turning to the Government Syllabus of Instruction for Public Schools issued in 1937—which repeated what had been there for many years—one discovers that whereas the doors of the State schools are kept tight shut against the eternal truths of Jesus Christ they are flung wide open to the manifold errors of Charles Darwin. The highly potent de-Christianising theory of organic evolution is laid down as one of the subjects to be taught to schoolchildren under the compulsory education system of New Zealand. Under the heading "Nature Study and Elementary Science" the syllabus says:

"The material for this subject is practically inexhaustible in that it comprises the whole of the animate population of the world together with the physical setting into which the many organisms have been born, and in which they have fought and are fighting their way upward to higher and yet higher stages of development. Ultimately Nature-Study should aim at enabling Man to understand and appreciate to some extent the scale of the universe and his own place in it" (pp. 42-3).

". . . The scheme should provide for progressive treatment of the subject as the pupils advance in their school life, and in the higher classes the pupils should gain some definite ideas of the principle of evolution" (p. 43).

In passing, it may be noted that the New Zealand public school syllabus is not altogether up-to-date in its idea of evolution. It visualises living things fighting their way in the struggle for existence to "higher and yet higher stages of development." Darwin, it is true, concluded the Origin of Species with a picture of "progress towards perfection" by natural selection. Modern evolutionists are now satisfied to discover grounds for imagining evolution in any direction, upwards or downwards, sideways or forwards, purposeful or purposeless. In the Oxford University book on Evolution (p. 125) we find Professor A. M. Carr-Saunders writing as follows :

"The course of evolution has generally been downwards The majority of species have degenerated and become extinct, or what is perhaps worse, have gradually lost many of their functions. The ancestors of oysters and barnacles had heads. Snakes have lost their limbs and penguins their power of flight. Man may just as easily lose his intelligence."

This learned professor is director of the London School of Economics, founded by Mr. Sidney Webb and his socialist Fabian Society and expanded with money obtained through Lord Haldane from Sir Ernest Cassel, international financier, which endowment

Lord Haldane told Mr. J. H. Morgan, K.C., had been provided "to raise and train the bureaucracy of the future Socialist State (vide Quarterly Review, January 1929). In addition to supervising this undertaking, Professor Carr-Saunders in the essay quoted above reveals himself as possessed of plans for human evolution. He says the "less well-endowed" sections of the population are breeding too freelv today and are far ahead of the "better endowed" sections. This evil can, in his opinion, be cured "once a cheap, efficient and simple contraceptive is available." This will enable the poor to behave the same as the "better endowed" do. Professor Carr-Saunders's idea is that when the lower orders are cured of the habit of having children the upper-crust can be encouraged to have them on patriotic grounds and upward evolution can then begin—that is, presuming that no other nation happens to take a fancy to possessing the depopulated country in the meantime. The big immediate step in human evolution, according to this professor, seems to be get the lower classes into the abortion parlours, etc., without delay.

While this book is in the press further comment on the communistic leanings of New Zealand intellectuals comes to hand in the December, 1940, issue of a little Auckland publication, View. Some leading lights of Auckland University College had protested against the efforts of the Auckland Education Board to keep the primary schools clear of communistic teachers, and View said : "Whatever may be the value ... of the operations of the University in the field of natural science, the prevailing trend of its influence in the sphere of human affairs—the 'social sciences'—is somewhat worse than worthless. Its deliverances fall below the commonsense of the average man. This does not apply to New Zealand alone, but to most of its sources of inspiration and recruitment overseas."

If View will dig deeper still it will find that the essential worth-lessness of present-day university teaching is that natural science has been made a vehicle for atheistic and materialist propaganda per medium of the imbecilities of the evolution theory. The modern university college is a machine for de-Christianising and demoralising the community.

APPENDIX

SCIENTISTS WHO REJECT EVOLUTION

Evolutionists commonly make statements leading the casual reader to believe that all scientists accept evolution as established fact. If these statements are attentively read, however, almost all of them will be found to contain an unobtrusive qualification. For instance, in the current fourteenth edition of the Encyclopaedia Britannica the article on evolution says that "among competent biologists and geologists there is not a single one who is not convinced," etc. This means no more than that in the opinion of the writer of the article the scientists who reject evolution are not "competent." Similarly, when the council of the American Association for the Advancement of Science in 1922 proclaimed by resolution that "the evidences in favour of the evolution of man are sufficient to convince every scientist of note in the world," they are likewise merely throwing dust in the public's eyes. All that the announcement means is that this scientific body is blacklisting the scientists who reject evolution and is refusing to regard them as of "note." This strain runs through evolution from top to bottom.

The following list of scientists who have definitely rejected the entire theory of organic evolution is compiled from a pamphlet by Lieut. Col. L. Merson Davies, from a leaflet issued by the Evolution Protest Movement, and from names mentioned in Mr. Douglas Dewar's books :

PHYSICISTS

SIR J. AMBROSE FLEMING, F.R.S.

President of the Victoria Institute and Philosophical Society of Great Britain, has been awarded many medals and honours by various scientific societies; inventor of the thermionic valve making radio broadcasting possible; has flatly rejected the entire theory of evolution in numerous addresses.

Louis TRENCHARD MORE

Professor of physics, University of Cincinnati, U.S.A., an expert physicist who has ridiculed evolution in his Dogma of Evolution (1925).

ZOOLOGISTS

ALBERT FLEISCHMANN, GR.

Professor of Zoology and Comparative Anatomy in the University of Erlangen, Germany, a scientist of European reputation: roundly attacked evolution in 1901 in his book, Die Descendenztheorie (1901), and remained completely unmoved by the abuse heaped upon him; in a letter to Col. Merson Davies in 1931 said : "I reject evolution because I deem it obsolete; because the knowledge, hard-won

since 1830, of Anatomy, Histology, Cytology and Embryology, cannot be made to accord with its basic idea"; attributes persistence of evolution to "mankind's love of fairy tales."

L. VIALLETON

Professor of Zoology, Anatomy, and Comparative Physiology at Montpellier University, France, member of the Royal Academy of Science of Turin (which marks him as a leading European scientist); attacked evolution in his Morphologie Generate (1924); his book L'Origine des Etres Vivants appeared in 1929 and ran through fifteen editions by 1930, but being strongly against evolution no English translation ever appeared.

E. G. DEHAUT

French biologist and palaeontologist, author of numerous scientific works, professes his belief in intervention of creative power to produce new types.

DOUGLAS DEWAR, F.Z.S.

An authority on Indian birds, rejected evolution in 1931; and has since written the following books condemning it: Difficulties of the Evolution Theory, More Difficulties of the Evolution Theory, Man, a Special Creation and A Challenge to Evolutionists: the latter being a report of his share of a debate (as representative of the Evolution Protest Movement) with Mr. J. J. McCabe (representing the Rationalist Press Association), who threatened legal proceedings if his part of the debate were published.

GEORGE BARRY O'TOOLE

A Catholic lecturer or professor of biology; author of The Case against Evolution, published by the Macmillan Co., New York, in 1931.

VINCENZO DIAMARE

Director of the Institute of Osteology and General Physiology in the University of Naples, rejected evolution in a book published in 1912.

D. CARAZZI

Another Italian biologist quoted by Vialleton, rejected evolution in his Il Dogma dell' Evoluzione, 1920.

GIULIO FANO

Director of the Institute of Osteology and General Physiology in the University of Rome; attacked evolution in his book, Brain and Heart, of which an English translation was published by the Oxford University Press in 1926.

BOTANIST

JOHANNES REINKE, GRR.

Emeritus Professor of Botany at Kiel University, Germany; has published many papers attacking evolution; he and Professor Fleisch-mann, hold rank in Germany equivalent to about that of Privy Councillors in England.

GEOLOGISTS PAUL LEMOINE

Past president of the Geological Society of France and director of the Museum d'Histoire; describes evolution as "a sort of dogma in which its priests do not believe, but which they uphold before the people" (vide Dewar's More Difficulties of the Evolution Theory).

W. BELL DAWSON, D.SC., F.R.S.C.

A well-known Canadian geologist and a Laureate of the French Academy of Sciences; like his father, Sir J. W. Dawson, F.R.S., former principal of McGill University, Canada, he is a determined opponent of evolution; author of The Bible Confirmed by Science, and various pamphlets including Is Evolution True ? No 1 to 5.

G MCCREADY PRICE

Professor of Geology, and author of The Phantom of Organic Evolution.

LT.-COL. I. MERSON DAVIES, F.R.S.E., F.R.A.I., F.G.S.

A palaeontological research worker specialising in foraminifera, who states that he is constantly face to face with facts regarding the fossil faunas of the past which he is unable to reconcile with the theory of evolution.

ARCHAEOLOGIST

SIR CHARLES MARSTON, F.S.A.

Vice-chairman of the British School of Archaeology in Egypt, member of the executive of the Palestine Exploration Fund, and collaborator with Professor Garstang in the excavation of Jericho; author of The Bible is True.

The above list is not exhaustive, but it is sufficient to show that when evolutionists state that no competent biologists or geologists, or no scientists of note, disbelieve in evolution they are not telling the truth. The information at hand does not disclose the religious beliefs of all the above-listed scientists. Professor Fleischmann is stated to be an agnostic, and Professor L. T. More appears from his remarks to have no respect for the authority of the Bible. Sir Ambrose Fleming, Sir Charles Marston, Professors Reinke and McCready Price, Dr. Bell Dawson, Lieut.-Col. L. Merson Davies, Mr. Douglas Dewar, and the Rev. G. Barry O'Toole are listed as of Christian belief. There are many other scientists who do not believe in evolution but have not so far publicly rejected it.

A. N. FIELD

THE EVOLUTION HOAX EXPOSED

(FORMER TITLE: WHY COLLEGES BREED COMMUNISTS)

This most important book should be read by everyone who considers himself educated, for it exposes as non-existent the supposed evidence to support the theory of evolution. Moreover, it gives extensive scientific proof that species reproduce themselves exactly and for as long as we have evidence of their existence. Because evolution is generally accepted in the educational world, every student and every teacher and professor has a professional obligation to examine the thesis of this work. The author's original title, *Why Colleges Breed Communists,* gives ample reason; the subject involves our understanding of how life comes to be. A fundamental mistake in so basic a concept can lead to all manner of error and abuse in the scientific, philosophic, theological and soc spheres.

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IS EVOLUTION PROVED?

A DEBATE BETWEEN

DOUGLAS DEWAR

AND

H. S. SHELTON

WITH AN INTRODUCTION BY THE EDITOR

ARNOLD LUNN

LONDON
HOLLIS AND CARTER
1947

THIS BOOK IS PRODUCED IN COMPLETE CONFORMITY WITH THE AUTHORIZED ECONOMY STANDARDS
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CONTENTS

		PAGE
	INTRODUCTION (BY ARNOLD LUNN)	1
CHAPTER		
1.	CAUSES OF EVOLUTION	25
2.	THE GEOLOGICAL RECORD (ITS VALUE)	57
3.	THE GEOLOGICAL RECORD (ITS CONTENT)	81
4.	GEOGRAPHICAL DISTRIBUTION	139
5.	MORPHOLOGY AND CLASSIFICATION	154
6.	EXPERIMENTAL EVIDENCE	186
7.	EMBRYOLOGY AND EVOLUTION	199
8.	ARE THERE NASCENT AND VESTIGIAL ORGANS?	222
9.	SOME INSTINCTS AND HABITS OF ANIMALS	239
10.	THE ORIGIN OF MAN	252
11.	SUMMARY AND CONCLUSION	286
	GLOSSARY BY H. S. SHELTON	336
	TWO CHARTS BY DOUGLAS DEWAR	341
	INDEX	342

INTRODUCTION

(1)

In the autumn of 1944 I learned from H. S. Shelton that he had just completed a controversial book in which he had collaborated with Douglas Dewar. I asked if I might see the manuscript, read it with immense interest, and recommended it enthusiastically to Messrs. Hollis & Carter who accepted it for publication.

Many years ago Shelton sent me a paper which he had contributed to *Mind*, which might without disrespect be described as the trade journal of professional philosophers. Shelton's paper struck me as the best essay on that particular subject that I had ever seen. The combination of philosopher and scientist is not common, with the result that most champions of evolution are very weak in logic. Sir Arthur Keith, for instance, in his book on Darwinism points out that there has been, in the course of ages, evolution in everything, in watches, for instance. But the question at issue is not whether men are different from fishes, or whether men appeared on the surface of the planet subsequent to fishes, but whether men are *descended* from fishes and unless Sir Arthur Keith could prove that my wrist watch is a blood relation of a sixteenth-century watch, his analogy has not the least relevance to the issue which is in dispute.

Shelton, who is a Bachelor of Science of London University, has published a large number of papers in *Mind*, *Journal of Philosophy*, *The International Journal of Ethics*, the *Proceedings of the Aristotelian Society* and *Science Progress*. He has written with great lucidity on the methods of reasoning employed in science, a good preparation for this book, since it is not as a rule the facts which are in doubt in this controversy but the inferences to be drawn from them. He has written two books on education, and one of them, *The Theory and Practice of General Science*, is the only book on the theory of general science as yet published in this country. He has also written *The Credibility of the Christian Faith*. He will attempt to show in this correspondence that the truth of organic evolution is so well established as to justify the teaching of it as a fact in an educational course.

Douglas Dewar took a degree in natural science in 1895, and then entered the Indian Civil Service. In India he took up ornithology as a hobby. His observations on birds led him to reject

successively Darwinism, the Darwinian theory of sexual selection and finally the whole concept of organic evolution. The results of his investigations are set forth in *Indian Bird Life* (1921). In 1931 he published his *Difficulties of the Evolution Theory* which was, as I happen to know, widely read among orthodox evolutionists, but in the main ignored in scientific journals. When Dewar, whose competence as a zoologist is admitted, submitted the statistics which he and Levett-Yeats had compiled on the all-important question of the fossil record (see chapter 2), these were not accepted by the Zoological Society of London on the ground that 'this kind of evidence led to no valuable conclusion,' a 'valuable' conclusion being a conclusion in accord with evolutionary orthodoxy. My own interest in evolution began at Oxford where I read Samuel Butler's attacks on Darwinism. I have been reading evolutionary literature, on and off, for the last thirty years, without coming to any very definite conclusions. I reject the theory of mechanistic evolution but I have an open mind on the question as to whether evolution has occurred. I am one of an increasing number of people who acquiesce in the fact that evolutionists are in a great majority, but who are not prepared to accept a dictatorship of evolutionists. We do not want a debatable doctrine rammed down our throats as if it had been proved beyond all possible doubt. We suspect that if the case for the opposition were as weak as it is represented to be, it would be less difficult than it is to get that case ventilated in scientific papers and in B.B.C. broadcasts.

Dewar's admirable persistence has, to some extent, broken down this conspiracy of silence. The evolutionists have been unable to leave his books unanswered, for in 1937 Dr. Morley Davies published his *Evolution and Its Modern Critics*, which was primarily designed as a refutation of Dewar's book.

There is, as I know from my correspondence, an increasing demand for a comprehensive statement of the pros and cons of evolution, a demand which this book should satisfy, for both Shelton and Dewar are masters of their subject. My role as Editor has been largely confined to the watching brief which I hold for the general reader who has no technical knowledge of this controversy, and both disputants have complied with suggestions for clarifying the more difficult points. The order in which the points are discussed is designed to familiarise the general reader with the subject before reaching the more technical chapters. Shelton would have preferred to lead off with the discussion on morphology which

he thinks to be the logical order. He will, however, have an opportunity in the last chapter of stating his case in his own way.

The general reader should not only consult the chart at the end of the book, but study it with some care so as to start the book with a general conception of the geological periods and the order in which the principal types appeared on the surface of the globe. He will find it useful to *memorise* the paragraph which follows. *Organisms are divided into two kingdoms, the animal and the vegetable kingdom. The animal kingdom is divided into phyla. Each phylum is divided into classes, each class into orders, each order into families, each family into genera, each genus into species.*

Thus a fox terrier and a spaniel are different *varieties* of the same *species*. The dog, wolf and jackal are different *species* of the same genus. The wolf and the fox are of different genera of the Canidae or dog *family*. This is one of the families of the *order* Carnivora. The Carnivora belong to the *class* Mammalia (animals that suckle their young), and the mammals belong to the *phylum* Vertebrata (backboned animals). Every animal belongs to a species, genus, family, order, class and phylum. Biologists give every species a double name, denoting its genus and species, thus the domestic dog is CANIS FAMILIARIS—the species FAMILIARIS of the genus CANIS.

The species is the smallest of the divisions which any special creationist would regard as the 'unit of creation.' Species are subdivided into varieties or breeds. Thus the pekinese and the St. Bernard are different breeds or varieties of the dog species.

The word OCtoPus may help the general reader to remember the relative order of the bigger divisions, for O.C.P. are the initial letters of Order, Class, Phylum.

In the original correspondence, Shelton adopted my use of the expressions *major* and *minor* evolution, instead of the more technical terms—*macro-evolution* and *micro-evolution*. By *major evolution* I mean evolution which transcends the limits of the *family*, by *minor evolution*, evolution within the limits of the family.

(2)

My task in this introduction is partly to define the issue, and to make it clear that there are other possibilities than mechanistic evolution and special creation, and partly to explain why a book, such as this, is particularly timely. It is not my task either to

defend or to attack evolution, but rather to expose the foolish conspiracy which represents evolution as a demonstrated fact which only cranks, fundamentalists or eccentrics, comparable to flat-earthers, could possibly deny. If this were true no publishing house of repute would publish this book, and no monthly of the high standing of the *Nineteenth Century and After* would publish three articles within eighteen months attacking evolution.

The man in the street still believes that Darwinism ranks with Copernican astronomy as a scientific certitude which fought its way to recognition in spite of ecclesiastical opposition, but it is at least arguable that Darwinism was accepted, in spite of the weakness of the scientific evidence, for theological or rather for theophobic reasons. Darwin has been anticipated by Buffon, Lamarck and Erasmus Darwin in the promulgation of evolution, and by Patrick Matthew in his advocacy of Natural Selection as the principal agent in the evolutionary process, and his immense success was partly due to the fact that he happened to restate these theories at the precise moment when theophobia (the fear or dislike of God) was on the increase, and when a majority of scientists were looking for some alternative to what Huxley calls the 'untenable theory of special creation.'

Darwin himself was a confused theist, but Darwinism was eagerly exploited by men who were searching for an answer to that great argument from design which was developed by St. Thomas Aquinas and popularised by Paley. Paley compared the intricate structure of the eye, with its numerous delicate adjustments, to the telescope and argued that it would be no easier to believe that the eye could be produced by chance than a telescope. We infer the designer from the design of the telescope, and the creator from the design of the eye.

Darwinism was supposed to provide an alternative explanation for the existence of design in nature, an explanation which rendered unnecessary the hypothesis of a Creator. 'If you can realise,' writes Mr. Bernard Shaw, 'how insufferably the world was oppressed by the notion that everything that happened was an arbitrary personal act of an arbitrary personal God of dangerous, jealous and cruel personal character, you will understand how the world jumped at Darwin.'

Fortunately for the world there are other alternatives than atheism and Calvinistic theism, but given Shaw's premise, the jump to the Darwinism conclusion was not unreasonable.

The argument of Darwinism may be briefly summarised as follows :

Individual members of a species vary, and these variations, however slight, affect the individual's chances of survival. Some individuals, for instance, will be fleeter than others and therefore better able to escape their enemies. A larger proportion of such individuals will survive long enough to reproduce themselves. Favourable variations are perpetuated, unfavourable variations tend to disappear. The gradual and progressive accumulation of small variations, under the influence of natural selection, will produce first a distinct variety, then a distinct species, and then transform one type of animal or plant into another type. Pure chance replaces the Creator. Favourable variations are blindly selected by a mindless environment.

Thus Darwinism appears to render superfluous the hypothesis of a Creator, which explains its attraction not only for atheists but also for all those scientists who would agree with P. Broca: 'Creation c'est le miracle en permanence, c'est la nature asujetté à une volunté et non à des lois—et alors s'il n'y a plus de lois, il n'y a plus de science.' Or as Sabatier puts it: 'God who is the final reason of everything is the scientific explanation of nothing.'*

Darwinism was accepted in spite of the fact that the geological record is eloquent in its witness to the suddenness with which new types appear and to the impossibility of tracing one family into another family by a time lineage series of fossils.

'In answer to the question,' wrote Huxley, 'what does an impartial survey of the positively ascertained truths of palæontology† testify in relation to the common doctrines of progressive modification? I reply: It negatives these doctrines, for it either shows us no evidence of such modification, or demonstrates such modification as has occurred to have been very slight.'

Huxley met Darwin some years before *The Origin of Species* was published, and expressed his 'belief in the sharpness of the lines of demarcation between natural groups and in the absence of transitional forms.' But by 1857 he was 'feeling that some working hypothesis must be found respecting the origin of known organic

* 'Creation implies the permanence of miracle, that is, nature subjected to a Will and not to laws. And if there be no more laws, there is no more science.' Quoted by Ronald Campbell Macfie in his excellent book *The Theology of Evolution* (Unicorn Press), p. 103.

† *Palaeontology*. This word which will recur again and again in this book means the study of *extinct* species whose characteristics can be inferred from their fossil remains.

forms *to replace the untenable separate creation theory*.' Why 'untenable'? Uncongenial no doubt. The ancestry of the horse helped Huxley to escape from the unwelcome hypothesis of a creating Deity.

'We must assume,' wrote Weismann,* 'Natural Selection to be the principle of the explanation of the metamorphoses because all other apparent principles of explanation fail us, and it is inconceivable that there should be another capable of explaining the adaptation of organisms *without assuming the help of a principle of design*.'[1]

'I am thoroughly persuaded,' wrote the great biologist Yves Delage in 1903, 'that one is or is not a transformist *not so much for motives deduced from natural history, as for motives based on personal philosophic opinions*. If there existed some other scientific hypothesis besides that of descent to explain the origin of species many transformists would abandon their present opinion as not being sufficiently demonstrated . . . If one takes his stand upon *the exclusive ground of facts* it must be acknowledged that the *formation of one species from another species has not been demonstrated at all*.'[2]

This same Delage, after pointing out with infinite regret the weak points in Darwinism, added: 'Whatever may befall this theory in the future, Darwin's everlasting title to glory will be that he explained the seemingly marvellous adaptation of living things by the mere action of natural factors without looking to a divine intervention, without resorting to any finalist or metaphysical hypothesis.'

In other words, Darwin's everlasting title to fame is that he provided the atheist with a plausible if untenable answer to Paley's argument from design.

Darwinism, as the great scientist *von Uexhull* said, '*is more a religion than a science*. Its logical consistency leaves as much to be desired as the accuracy of the facts on which it is based. That is why all arguments against it remain ineffective. It is nothing but the embodiment of the determination to rid nature at any cost of the principle of order (Planmässigkeit). In this way the idea of evolution has become the sacred conviction of thousands, *a conviction that has no longer anything to do with unbiased scientific research*.'

Theophobia as the motive for the acceptance of Darwinism

* Italics always mine unless the contrary is stated. The italics, which are Weismann's, emphasise the horror with which he rejected the alternative of divine creation, but there is nothing scientific about the confession 'We must *assume*' to be true the only plausible alternative to the hypothesis of a creating God.

emerges very clearly in the following quotation from *du Bois-Reymond* : 'Whoever does not place all activity wholesale under the sway of Epicurean chance, whoever gives only his little finger to teleology will inevitably arrive at Paley's discarded *Natural Theology*, and so much the more necessarily the more clearly he thinks and the more independent his judgment . . . The possibility, ever so distant, of banishing from nature its seeming purpose, and putting a blind necessity everywhere in the place of final causes, appears, therefore, as one of the greatest advances of the world of thought, from which a new era will be dated in the treatment of these problems. To have somewhat eased the torture of the intellect which ponders over the world-problem will, as long as philosophical naturalists exist, be Charles Darwin's greatest title to glory.'

Professor D. M. S. Watson who was the principal speaker in a series of broadcasts (October 2nd to December 18th, 1942) informed a body of scientists at Cape Town that '*Evolution itself is accepted by zoologists not because it has been observed to occur or can be proved by logically coherent evidence to be true*, but because the only alternative, special creation, is clearly incredible.'[3]

Biologists have, of course, been always free to criticise particular theories of evolution, such as Darwinism, but the truth of organic evolution has been accepted as a quasi-religious dogma which it would be blasphemous to criticise. Whereas a Christian can be a Darwinist, an atheist cannot reject evolution. Mechanistic evolution is *de fide* for the atheist, and consequently evolutionary controversy is embittered by the odium anti-theologicum. Evolution, as Sir Arthur Keith remarks (*Darwinism and Its Critics*), is a basic dogma of rationalism.

There are welcome signs that the religiosity which has so far protected the dogma of evolution from scientific scrutiny is breaking down. Dr. W. R. Thompson, after remarking that 'the concept of organic evolution' was 'an object of genuinely religious devotion,' adds : 'this probably is the reason why severe methodological criticism employed in other departments of biology has not yet been brought to bear against evolutionary speculation. *There are, however, indications that this criticism will not long be delayed.*'[4]

The great majority of biologists still accept organic evolution, and the appeal to authority would therefore tell heavily in Shelton's favour, but the quotations which follow establish the one fact which I am concerned in this introduction to establish, the existence of an important minority of distinguished scientists who either

reject evolution or who realise that evolution still lacks adequate proof. I shall only quote a small selection of representative men. It is perhaps hardly necessary to point out that the letters F.R.S. (Fellow of the Royal Society) designate a member of the scientific *élite* of Great Britain.

The minority of those who have the courage to challenge the dogma of evolution is, of course, far smaller than the number of those who dare not express their doubts. It is, as a Fellow of the Royal Society once remarked to me, professional suicide for a biologist to attack organic evolution as such. 'The tyranny of the *Zeitgeist* in the matter of evolution,' wrote Dwight, Parkman Professor of Anatomy at Harvard, 'is overwhelming to a degree of which outsiders have no idea. Not only does it influence (as I admit it does in my own case) our manner of thinking, but there is oppression as in the days of the Terror. How very few of the leaders of science dare to tell the truth concerning their own state of mind.'[6]

And now for a few quotations from the sceptics who *have* the courage to proclaim their scepticism. *Sir Ambrose Fleming, F.R.S.*, was a convinced creationist. He rejected evolution. *Sir J. William Dawson, F.R.S.* (obit. 1899), Professor of Geology and Principal of McGill University, writes: 'the evolutionist doctrine is itself one of the strangest phenomena of humanity, but that in our day a system destitute of any shadow of proof, and supported merely by vague analogies and figures of speech, and by the arbitrary and artificial coherence of its own parts, should be accepted as a philosophy, and should enable adherents to string upon its thread of hypotheses our vast and weighty stores of knowledge is surpassing strange.'[6]

Dr. Fairfield Osborn, former Curator of the American Museum of Natural History, an evolutionist troubled by doubts, writes: 'Between the appearance of the *Origin of Species* in 1859 and the present time there have been great waves of faith in one explanation and in another; each of these waves of confidence has ended in disappointment, until finally we have reached a stage of very general scepticism.'[7]

Dr. Austin H. Clark, of the United States National Museum, Washington, writes: 'Thus so far as concerns the major groups of animals, the creationists seem to have the better of the argument. There is not the slightest evidence that any of the major groups arose from any other.'[8]

Professor D. H. Scott, F.R.S.: 'For the moment at all events, the Darwinian period is past. We can no longer enjoy the com-

fortable assurance which once satisfied so many of us, that the main problem has been solved, all is again in the melting pot.'

Professor T. H. Morgan, Nobel prize winner in 1933 : 'Within the period of human history we do not know of a single instance of the transformation of one species into another, if we apply the most rigid and extreme tests used to distinguish wild species from each other. It may therefore be claimed that the theory of descent is lacking in the most essential feature that it needs to place the theory on a scientific basis.'[10]

European scientists have, on the whole, been less uncritical in their acceptance of evolution than British scientists. *Oswald Spengler* was not a scientist, but he was well informed about scientific opinion, and the following passage from his famous book, *The Decline of the West*, is evidence as to growing scepticism about evolution. Spengler's religious views are difficult to discover, but his theology seems to be pantheistic. In the following passage he uses 'Darwinism' as a popular equivalent for 'evolution.'

'Palaeontology,' he writes, 'furnishes the most conclusive refutation of Darwinism. According to the laws of probability, fossil deposits are only test samples. Each sample should therefore represent a different phase of evolution, and in this case there would be no transitional forms, no boundaries, and also no species. Instead of this we find completely stable and unchanging forms persisting through long ages, forms which have not evolved in accordance with the principle of adaptation, but appear suddenly and at once in their final form.' And elsewhere Spengler remarks that 'the Materialism and the Monism and the Darwinism, which stirred the best minds of the nineteenth century to such passion, have become the world-view proper to country cousins.'[11]

The most remarkable evidence of increasing scepticism about evolution is contained in the volume which lies before me as I write, the fifth volume of the *Encyclopédie Française*, which is devoted to *Les Êtres Vivants. Plantes et Animaux.* To this volume, published like its predecessors by the famous house of *Larousse*, eminent French scientists contribute. The editor, Paul Lemoine, was a former Director of the National Museum of Natural History at Paris. The concluding essay in this volume is by Lemoine and is entitled 'Que Valent Les Theories de l'évolution ?' 'What are the theories of evolution worth ?' Lemoine answers, in effect, that they are worth nothing. 'The theories of evolution,' he writes, 'in which our student youth was cradled, constitute a dogma which all

the world continues to teach : but each in his speciality, zoologist or botanist, comes to the conclusion that none of the available explanations are adequate.' Lemoine then analyses in detail the difficulty of reconciling evolution with palaeontology and biogeography. And he concludes his chapter with the following words : 'Il resulte de cet exposé que la theorie de l'évolution est impossible. . . . Cela il faut avoir le courage de le dire, pour que les hommes de la génération future orientent leurs recherches d'une autre façon.' (It results from this summary that the theory of evolution is *impossible*. . . . It is necessary to say this in order that future generations may orientate their researches in another fashion.)

(3)

The evolutionist who is forced to concede the strength of the case against evolution usually asserts that 'evolution is the only *scientific* hypothesis for explaining the origin of species.' I disagree. 'All the new types appeared suddenly on the surface of the globe' has as much right to be considered a scientific hypothesis as the statement : 'All new types have evolved *gradually* from existing types.' These rival hypotheses must be compared with reference to the palaeontological, morphological and embryological evidence. If the evidence suggests that new types appeared suddenly, we can still defend the hypothesis that they were spontaneously generated, for it is only the defect of imagination which blinds us to the complexity of the first living organism and which makes it easier for us to accept the spontaneous generation of a one-celled organism than of a bird. Admittedly if we could establish the fact that new types had appeared suddenly, most people would accept special creation, but why this conclusion, *if in accord with the facts*, should be less 'scientific' than evolution I cannot see. If, on the other hand, we mean by 'evolution' the theory that species have evolved by a purely natural process, and if by 'scientific hypothesis' we mean a hypothesis which excludes supernatural agencies, the statement : 'Evolution is the only scientific hypothesis' is a glimpse of the obvious.

Consider the two following hypotheses. *First, the hypothesis of mechanistic evolution.* Life appeared on the surface of the cooling planet by an action of spontaneous generation. From the mud, rocks, mists and sea of the primeval planet all living things evolved by a purely natural process. *Second*, the hypothesis that you can't extract plus from minus, or qualities in an effect which were not

present in the cause. No purely natural agency would therefore have sufficed to transform the mud, rocks, mists and seas of the primeval planet into the minds which enriched the world with the sonnets of Shakespeare or with Beethoven's *Ninth Sonata*.

'Science' means knowledge, and a good scientific hypothesis is a hypothesis which takes into account all available and relevant knowledge. If supernatural agencies have played a part in the origin and development of species, a valid scientific hypothesis will allow for such agencies. Nothing could be less scientific than to rule out in advance any particular class of agencies, natural or supernatural, as unworthy of investigation.

It is, of course, the duty of the scientist to make every possible attempt to explain phenomena in terms of natural agencies, but it would be unscientific, as Shelton would agree, to cling tenaciously to an unsound hypothesis merely because its rejection would involve the admission that supernatural agencies were partially responsible for the phenomena under investigation.

I have sometimes wondered whether the irrational and fanatic resistance to the possibility of miracles was wholly unconnected with the mental climate of the England in which Deism was popularised. Deism, the theory that God created the world, and then left it severely alone, became fashionable in England at the time of the 'Glorious Revolution' of 1688, the revolution which substituted a limited for an absolute monarch. The god of Deism is a constitutional monarch. The King of England has a theoretic right to veto laws approved by Parliament, and the God of Deism has a theoretic right to veto the laws of nature, but neither the King of England nor the King of Kings would venture to exercise these theoretic rights. Miracles are as objectionable to the Deist as the arbitrary acts of an absolute monarch to the historian of the Whig tradition. Deism, in fact, might be defined as constitutional Theism.

Before attempting to summarise the attempts to explain the origin of species, it will be as well to determine in advance our standards of proof. The statement that the depth of the sea is greater than five feet admits of *coercive* proof. The sceptic would be coerced into this belief by throwing himself off the deck of a cross-channel steamer. Neither Shelton nor Dewar expect to *coerce* the unbiased reader into acceptance of their respective positions. All that they claim to offer is *persuasive* proof, proof which should persuade an intelligent and reasonable reader.

Nobody has ever witnessed an act of special creation, and

nobody has witnessed the transformation of species, so far, at least, as the animal kingdom is concerned. Both the evolutionists and the special creationists rely on inferences from the geological record and from the structure of living things in the world to-day. Evolutionists sometimes remark with airy denigration that 'special creation' is one of those theories that one can neither prove nor disprove. Much the same might be said of evolution. Neither the evolutionist nor the special creationist claim that they can provide coercive proof. Both claim to provide proof which is believed to be 'persuasive.' The burden of proof, both in the case of evolution and in the case of special creation, lies on him who asserts. If, for instance, you were to assure me that the dog who has just come into the room in which we are sitting was specially created in the course of to-day I should reply by quoting Bishop Butler's remark: 'Probabilities are the guide to life.' It might be difficult to disprove your assertion, but having acted as midwife to a spaniel and seen dogs born and met dogs at every stage of existence from new-born puppies to senile and decrepit veterans, I shall continue to believe that the dog who has just entered the room was born in the normal way unless you produce coercive proof to the contrary. I have never seen a dog specially created and I have never seen one type of animal evolve into another type, and I shall therefore continue to record a verdict of 'not proven' until either the special creationist or the evolutionist produce persuasive proof in favour of their views.

We may reject a hypothesis which cannot be coercively refuted, if it is unsupported by adequate evidence or if it conflicts with conclusions based on other premises. Thus Mr. Philip Gosse's theory, described below, that the world was created in six working days of twenty-four hours each, complete with fossils to suggest that the planet had been in existence for millions of years, conflicts with the conclusions of rational theology.

Mr. Gosse, who did not believe in evolution, was embarrassed by the fossils in the geological record, and one might therefore reasonably expect that the evolutionist would not only welcome the appeal to the geological record, but also make every effort to prove that this record is reliable, but in the original form of the correspondence between Dewar and Shelton, it was Shelton who was urging with eloquence that the geological record is imperfect and fragmentary, and Dewar who was maintaining that it is, on the contrary, representative and sufficiently complete to serve as the basis for definite conclusions.

The truth is that the geological record, though it negatives the crude fundamentalism which asserts that the world was created in six working days of twenty-four hours each, is, perhaps, easier to reconcile with special creationism than with evolution, for all the new types appear suddenly in that record. It is impossible to bridge the gap between any of the families in nature by means of a *true lineage series of fossils*, by which I mean a gently graded series of fossils linking an ancestor A, with a descendant B, each member of the series being slightly less like A and slightly more like B than its immediate predecessor in the series. Not only is it impossible to produce a true lineage series between families, and *a fortiori* between classes, orders, or phyla, but as Vialleton, for fifty years professor of comparative anatomy at the University of Montpellier, says: 'It has only rarely been found possible to trace a genus, step by step, and without artifice into an earlier genus, moreover, when this can be done, it is never a case of two creatures essentially different in their organisation but of neighbouring forms of which the organisation continues in the same line.' No lineage series of fossils connecting families, much less different classes, orders, phyla have been found.

Shelton is not only a scientist but a metaphysician. I therefore hope he will solve what always seems to be a logical dilemma in the evolutionary case. Shelton would agree that the fossil of a horse in the earliest Cambrian strata or of a human skull in the secondary strata would knock the bottom out of the evolutionary theory. By what right does the evolutionist assert that the missing volumes in the geological record contain *no* evidence difficult to reconcile with evolution (e.g. *equus* fossils in the Cambrian) and *all* the evidence he requires to prove evolution, i.e., the millions and millions of missing links?

Why should the evolutionists be entitled and the anti-evolutionist not entitled to draw definite conclusions from the *absence* of fossils from any particular strata? Surely the geological record is either sufficiently complete to draw definite conclusions, in which case we can assert with confidence not only that fishes appeared before men, but also that the absence of missing *chains* (for it is the chains which are missing, the links which are present) is fatal to the theory of slow gradual evolution, or alternatively that the record is so fragmentary that no conclusions of any value, favourable to or hostile to evolution, can be drawn from it.

(4)

All theories which profess to explain the origin of species may be divided into four main groups.

1. *Atheistic evolution.* There is no God and therefore no supernatural creative activity. The origin of life and the origin of species are explicable as the result of natural agencies and natural law.

2. *Deistic evolution.* God exists and created the world, but does not interfere in the process of creation. There is nothing miraculous in the origin of life or in the origin of species. Both can be explained as the result of natural agencies without invoking supernatural intervention. For controversial purposes, atheistic and Deistic evolution are indistinguishable, but a man need not be a Deist in theology to be a deistic evolutionist. Many Catholic biologists are Deistic evolutionists, so far at least as the evolution of man's *body* is concerned.

3. *Special creation.* There is nothing in this theory repugnant, as Philip Gosse's theory is repugnant, to an exalted conception of God. Neither the philosopher nor the scientist can adduce a single valid reason against the *possibility* of special creation. The principal obstacle to the acceptance of special creation is neither science nor philosophy, but fashion. The mental climate of the day renders it difficult for us to accept special creation. Phrases such as 'fundamentalism,' 'the Bible belt,' etc., handicap the special creationist by importing emotional prejudices into what should be a purely scientific discussion, but our attitude to this hypothesis should be determined by the evidence. If, for instance, the evolutionist could produce true lineage series of fossils linking family with family, and class with class, and order with order, and phylum with phylum, I for one would have no hesitation in rejecting special creation. If, on the other hand, the special creationist had a completely satisfactory answer to the horse series, to vestigial remains, and to the embryological evidence, I should regard the suddenness with which new types appear as conclusive in favour of special creation.

4. *Theistic evolution,* differs from *special creation* in that it postulates the evolution of man's body from that of the simplest forms of life, and differs from *Deistic evolution* in that it invokes supernatural activity to bring about the more radical changes in the human pedigree. Natural agencies, according to this view, are

adequate for minor evolution but require to be supplemented by supernatural agencies to provoke major evolution.

Wallace who shares with Darwin the credit for promulgating the theory of Natural Selection did not believe that natural forces alone could account for the ascent of man. He suggested that there were 'three stages in the development of the organic world when some new cause or power must necessarily have come into action, the first when the first living cell was created, the second when the animal kingdom separated from the vegetable kingdom, and the third at the creation of man.'

We can either opt for one of these four theories, or can return a verdict of 'not proven' against any one or all of these theories. Many readers of this book will begin with strong prejudices for or against evolution, and such readers (and reviewers) will pounce with delight on anything which tells in favour of their views, and will ignore what tells against them, but there will be others who after weighing the difficulties of evolution against the difficulties of special creation will refuse to commit themselves either to special creation or to any form of evolution, atheistic, deistic or theistic.

For many years I studied snow and avalanches, and my theories have stood the test of searching examination by scientific investigators in different countries because I never felt under the least obligation to pretend that problems which were unsolved had, in fact, been solved. I refused to choose between rival theories if both theories seemed to me unsupported by evidence. Any form of research which affects men's lives or pockets discourages irresponsibility. A rash diagnosis of a snowslope, or even a faulty theory about snow, expressed in print may result in a fatal avalanche accident, but nobody is a penny the worse if an evolutionary pedigree proves to be false, all of which encourages a certain light-hearted irresponsibility, unknown in other branches of scientific research.

I am inclined to suspect that the agnosticism which returns a verdict of 'not proven' on the evolutionary issue is more common in scientific circles than it was. 'The only statement,' wrote the great biologist Reinke, 'consistent with her dignity that science can make is to say that she knows nothing about the origin of man.'[11] 'We have reached,' says Dr. Fairfield Osborn, 'a stage of very general scepticism.'[12] 'A student,' writes Sir Albert Seward, F.R.S., 'who takes an impartial retrospect soon discovers that the fossil record raises more problems than it solves . . . we want to know where we are; faith, as Dr. Bateson says, has given place to

agnosticism ; it is necessary to start afresh, to see things as they are, and not as we think they should be.'[14]

The transformation of agnosticism into faith will not be achieved by a process of piling up new evidence, so long as the unresolved difficulties remain unexplained.

(5)

St. Thomas Aquinas said that no rational argument was possible until a common premise had been discovered, and for this reason he began his famous five proofs of the existence of God with a premise common both to the theist and to the atheist, the fact that 'some things are in motion.'

It will clarify the discussion if we begin by deciding what premises are and what are not common to Shelton and to Dewar. Here then are my suggestions for premises which I believe that they will both accept, though Shelton may perhaps cavil at one or more of them.

1. *A hypothesis is not necessarily plausible because it cannot be refuted.*

You cannot refute the man who believes that he alone exists and that the world process exists only in his imagination.

2. *A hypothesis deserves consideration* if

(a) it is not inherently absurd, and *if*
(b) it is supported by plausible arguments and *if*
(c) a plausible reply can be made to the arguments against it.

3. *The hypothesis of a Creator is not inherently absurd.*

It would be an understatement to describe this as an understatement.

4. *We must not accept a miraculous explanation of any phenomenon before we have examined all possible explanations in terms of natural causes.*

Dewar and I began as evolutionists. Dewar is a special creationist and I am, so far as evolution is concerned, an agnostic, because all attempts to explain the evolutionary process solely in terms of natural law seem to be completely unconvincing.

5. *The hypothesis that the different species*, or *the different genera*, or *the different families came into existence by an act of special creation is not inherently absurd.*

Huxley admitted that 'the philosophical difficulties of theism are neither greater nor less than they have ever been since theism was invented.' He also admitted that ' "creation" in the ordinary sense of the term is perfectly conceivable' and that 'The *a priori* arguments

against theism, and given a deity, against the possibility of creative acts, appear to me devoid of reasonable foundation.'

In other words that there is nothing inherently improbable either in the existence of a Creator or in creative acts.

Special creation qualifies under 2(a), 2(b) and 2(c) as a hypothesis which deserves consideration because it is not inherently improbable, because it is supported by plausible arguments, and because a plausible reply can be made to the arguments against it. Special creation, the traditional belief of Christendom, is consistent with the noblest conception of God. It does not offend, as Philip Gosse's theory offends, our sense of ethical probabilities.

It is, of course, easy to understand that those whose mental outlook is entirely coloured by the prevailing fashions in thought often refer to special creationism as if it ranked with flat-earthism, forgetting that whereas no scientist of standing believes that the earth is flat, many distinguished scientists believe in special creation.

I can understand this attitude because to some extent I am affected by it. I find it difficult to believe in the creation of, say, a bird *ex nihilo*, not because there is *a priori* reason why the Creator should not create a bird *ex nihilo*, but because I am influenced by the mental climate of the age in which we live. And for this reason I can appreciate the attraction of Deistic creation, for this hypothesis relegates the act of creation to the remote past before the earth came into existence, and absolves us from the tiresome necessity to allow for creative acts in the evolution of species.

There is, of course, no *a priori* reason why creative acts should have come to a sudden end before the first living cell appeared on the surface of the planet.

6. The Ambi-Neuter Postulate.

Facts which are equally consistent with BOTH of two rival theories can be cited in support of NEITHER of these theories.

Ambi-neuter is a clumsy word, but until Shelton can think of a better, I propose to use it, for a clumsy word is better than none in so far as it saves space in future references to a postulate of immense importance in this controversy.

If special creationism and evolution are hypotheses, both of which deserve consideration, we must clearly not cite facts which are equally easy to reconcile with both hypotheses as if they told in favour of either of them.

Thus the fact that fishes appear on the surface of the planet before men is equally consistent with evolution and with the first

chapter of Genesis. Again there are many facts of geographical distribution which are as easily reconciled with the theory that evolution began on the mainland as with the theory that species which had been specially created on the mainland subsequently migrated across land bridges which have now disappeared, to the various islands in which they have been found.

Again an intermediate type wholly distinct from the two types between which it is alleged to be intermediate yet containing characteristics of each type is as easy to reconcile with the creationist as with the evolutionist hypothesis. There is no *a priori* reason why the Creator should begin *de novo* with each type, or why he should not introduce into a new type some features which have occurred in earlier types. The human creator does not begin *de novo* every time he tries to design a new car or a new plane. The Fighter Bomber is an intermediate between the Fighter and the Bomber, but the Fighter Bomber is not a blood relation of the Fighter.

Shelton may be tempted to retort that the *ambi-neuter* postulate might be invoked to justify absurd theories such as for instance the theory put forward in *Omphalos*. The author of *Omphalos* was Philip Gosse, a great naturalist and a Plymouth brother, and the thesis of Omphalos is that God created the world, just as it is, fossils and all complete. The world was created in six days, of twenty-four hours, somewhere about 4000 B.C. As the world and the fossils were created together, the world instantly presented the structural appearance of a planet on which life had existed for millions of years.

No coercive disproof of this hypothesis is possible, but Gosse's theory of creationism does not qualify as a hypothesis which needs to be taken seriously under 2(b) because it is not supported by plausible arguments.

Moreover we can reject it under 2(a), for it conflicts with our sense of ethical probabilities. It is, as Charles Kingsley said, 'Unthinkable that God has written on the rocks one enormous and superfluous lie.' Admittedly there are *many* facts which are equally easy to reconcile with Gosse's theory and with Dewar's conception of creationism, and *those* facts cannot be cited as evidence against Gosse. We reject Gosse's theory not by citing facts equally consistent with his theory and ours, but by an appeal, in the first place to 2(b), since Gosse's theory is unsupported by any evidence, and in the second place because it is inconsistent with rational theology.

Similarly if Shelton could produce a true lineage series of fossils linking family to family, class to class, and order to order, and phylum to phylum we should accept this as decisive evidence for evolution in spite of the fact that it would still be possible to assert that every species, represented in the graded lineage series linking class with class, had been specially created.

We should reply that coercive evidence, such as this, for evolution could only be rejected by those who were prepared to believe that God had 'written on the rocks one enormous and superfluous lie.'

The *ambi-neuter* postulate is self-evident. If, for instance, *all* the facts which Dewar and Shelton could produce were equally easy to reconcile with evolution and creationism, agnosticism would be the only reasonable attitude, but this is not the case. There are facts, which are easier to reconcile with evolution than with creationism and there are other facts which are easier to reconcile with creationism than with evolution.

Both theories, special creationism and evolution qualify under 2(a), (b) and (c) as theories which deserve consideration, and neither Shelton nor Dewar will therefore attempt to *sneer* their opponent out of court.

(6)

The omission of all discussion of the *causes* of evolution was a serious defect in the original correspondence. Dewar, at least, can suggest a *vera causa* for living species. Clearly if one believes in God there is no *a priori* reason why the different species (or genera, or families) should not have come into existence as acts of special creation. The atheistic or Deistic evolutionist must attempt to produce an adequate substitute for the creative power of God. He must suggest a *vera causa* capable of evolving from the mud, sand, mists and sea of the primeval planet the living things which we see around us, and also many other things which do not exist in inorganic matter, as for instance our reaction to beauty.

May I therefore invite Shelton to give his idea of the *vera causa* of evolution and then to comment on the following points and show how they can be explained in accordance with his theory.

1. Natural Selection is a negative process. It cannot select what is not there. The survival of the fittest, as somebody remarks, does not explain the arrival of the fittest. The presence of weeds in a garden is not explained by the fact that the gardener has not removed them. Natural Selection, Darwin argued, may be said

to create a new species out of fortuitous variations as truly as man may be said to create a new building out of the material provided by the stones of various shapes. He accepted variations as a fact, but made no attempt to explain the origin of these variations, out of which the negative action of Natural Selection was alleged to create new species. But unless we can explain the origin of variations, we cannot hope to explain the origin of species.

My first contention is therefore that purely natural forces are inadequate either to produce from the mud, seas, mist and rocks of the primeval planet the variations which are the raw material for Natural Selection, or to bridge the gulf between the different types.

2. Here is a passage which I quoted some years ago from *The Modern Adventure* by Mr. W. J. Blyton. Mr. Blyton gives no reference, but it would be an insult to Shelton to suggest that he would need the context to understand a passage which is characteristic of Whitehead's clear and logical reasoning. I draw Shelton's particular attention to the italicised passages in which Professor Whitehead suggests that Darwinism offers no explanation (a) why the process should ever have occurred (b) why the trend of evolution should be upward. What is Shelton's answer to (a) and (b)? Professor Whitehead points out that the doctrine of organic evolution does not in the least explain why the process should ever have occurred. '*The phrase "survival of the fittest" offers no explanation. For life itself has very little survival value compared with the inorganic matter from which it sprang.* A rock survives for hundreds of millions of years, whereas even a tree lasts only a thousand years. If survival was what Nature aimed at why should life appear at all? *Again why should the trend of evolution be upwards so that higher and higher types are evolved?* The doctrine of evolution does not explain this. *The upward trend cannot be due to the influence of environment, for the lower types are just as well adapted to their environment as are the higher types.*'

Professor A. N. Whitehead, F.R.S., is an eminent mathematician and philosopher. I should be grateful for Shelton's comments on the italicised passages.

3. It is difficult to understand how natural selection could in Darwin's words create new species out of fortuitous variations which in their stage are not advantageous. The feathers of the first bird are supposed to have evolved from the scales of a reptile. 'Fine feathers do not make a bird,' nor a few feathers a flyer. Feathers would have to be present not only in great quantity, but also in an advanced stage of development before the parent bird could

even glide downwards from a tree, let alone lift itself from the ground.

4. If evolution is a gradual process (and if a reptile is mutated into a bird overnight by a sudden *mutation*, you might as well postulate special creation) then there must have been a time in the past when the world was full of transitional types, reptiles with a few rudimentary feathers for instance. The evolutionist must therefore explain not only the apparent suddenness with which new types appear in the geological record, but also the sharpness of the lines which divide species in the world to-day. Darwin in the sixth chapter of his book tries to meet this difficulty. 'Why do we not see everywhere,' he writes, 'innumerable transitional forms? Why is not all Nature in confusion, instead of the species being as we see them, well defined?' Darwin's answer was that the evolution of species is determined among other things 'by the presence of other species, on which it lives, or by which it is destroyed, or with which it comes into competition, and as these species are already defined objects, not blending into each other by insensible graduations, the range of any one species, depending as it does on the range of others, will tend to be sharply defined.'

Now, in the first place, as Kellogg remarks, this is a *petitic principii:* 'The sharp definition of species, that we started out to account for, is explained by the sharp definition of other species.' And, in the second place, Darwin ignores the fact that there must have been a time in the past when all Nature was 'in confusion,' when the slow changes which he postulates were taking place. His explanation virtually assumes that evolution has ceased to operate.

5. It seems to me impossible to explain the evolution of very complex organs such as the eye, which consist of several parts, parts which cannot function satisfactorily unless they are accurately fitted together. 'One might possibly,' writes Wolff, 'imagine the adaptation between one muscle cell and one nerve end through selection among innumerable variations, but that such should take place in a thousand cases in one organism is inconceivable.'

As Berg, a Soviet scientist remarks, 'the probability that all useful variations will simultaneously occur is the probability of a miracle.'

If there be no directive and supernatural intelligence at work in the controlling and ordering of the development of life, we have to endow *pure chance* with miraculous power.

Is it conceivable that so complex an optical instrument

as the eye could be improved by *pure chance*? Mr. Noyes, in his book *The Unknown God*, quotes a Savilian professor of astronomy on this subject. 'Suppose, for instance, one of the surfaces of the crystalline lens of the eye to be accidentally altered, then I say that unless the form of the other surface is *simultaneously* altered in one only way *out of millions of possible ways*, the eye would not be optically improved. An alteration in the two surfaces of the crystalline lens, whether accidental or otherwise, would involve a definite alteration in the form of the cornea, or in the distance of its surface from the centre of the crystalline lens, in order that the eye may be optically better. All these alterations must be simultaneous and definite in amount, and these definite amounts must coexist in obedience to an extremely complicated law.

'To my apprehension then that so complicated an instrument as the eye should undergo a succession of millions of improvements by means of a succession of millions of accidental alterations is no less improbable than if all the letters in *The Origin of Species* were placed in a box and on being shaken and poured out millions and millions of times should at last come together in the order in which they occur in that fascinating and, in general, highly philosophic work.'

Again it is very difficult to explain by the unplanned selection of chance variations the existence in the same organism of identical structures. 'It cannot,' writes Wolff, 'be explained by selection how the carnivores, for example, can have developed through fortuitous yet always similar variations, two such structures agreeing in all details as back teeth, which have developed in course of time from small skin teeth. That a tooth can develop into such an admirable biting organ through chance variation can be explained by selection, but that the tooth standing next to it shall have varied always *in exactly the same way* so that the result of its development shall make it *identical with the other one*, is inexplicable by selection on a basis of fortuitous variation, but rather indicates that the change of form is ruled by law which we do not know.'

6. Finally how do you explain the sense of beauty? Was the emotion which the Wetterhorn, the *Sixth Symphony*, and Chartres evoke in me implicit in the mud, rocks, mists and sea of the primeval planet? Darwin's attempt to meet this difficulty was characteristically evasive. He assumed what it was his business to explain, the existence of a sense of beauty and then proceeded to discuss the influence of this sense on evolution. The female is attracted

by a beautiful mate, with the result that ugly varieties tend to end their days disconsolate bachelors, whereas beautiful varieties leave a numerous progeny. No doubt, but *why does the peahen think the peacock beautiful*? Is it conceivable that a blind and fortuitous process, undirected by intelligence, could have evolved from lifeless matter of the primeval planet the power to create and the power to appreciate beauty? The art of primitive man proves him to have possessed the power to create beauty, and those who accept Darwin's theory of sexual selection must attribute to the animal creation the power to appreciate beauty.

The points on which I invite you to comment raise no difficulty, either for the special creationist or for the theistic evolutionist. The latter believes that the body of man has evolved from the body of animals, but he affirms that this process has throughout been guided and directed and controlled not only by natural, but also by supernatural agencies. The theistic evolutionist does not believe that the blind and unplanned and fortuitous forces of nature are sufficient to evolve from the mud, sand, mists and seas of the primeval planet the brain that conceived and the minds that enjoy Beethoven's *Sixth Symphony*.

The Deistic evolutionist, on the other hand, affirms that it is unnecessary to postulate any supernatural forces or miraculous intrusions to account for the origin and evolution of species. And it seems to me, though I may be wrong, that the atheistic and Deistic evolutionists are necessarily forced to adopt some form of neo-Darwinism. If we reject a supernatural control of the evolutionary process, we must fall back on the blind and fortuitous processes, and thus inevitably rely more and more on natural selection as the key to the evolutionary process. For myself I agree with Dr. Inge that 'the notion that a species is evolved blindly and fortuitously could only be accepted when it was rammed down our throats.'

Let me end with a suggestion to the reader. If his mind is closed to evidence which conflicts with his beliefs he will, of course, 'floodlight' those parts of the book with which he is in agreement. If he is an evolutionist his pupils will dilate when he reads Shelton on the evolution of the horse and contract when he reads Dewar on the suddenness with which new types appear. Equally, if he is a special creationist his pupils will dilate when he reads Dewar on nascent organs and contract when he reads Shelton on vestigial remains.

If, on the other hand, he has an open mind on the whole question he will not adopt the floodlighting technique.

Whether a verdict arrived at by taking into consideration all the relevant facts would be in favour of or against evolution is for the reader to decide. I suggest that he should keep a careful round-by-round record of this controversy, crediting the two opponents with points as if he were the referee in a boxing match. Readers who adopt this method will differ as to who wins on points, but I am confident that they will be grateful to both controversialists for the skill with which they have stated the case for and against the hypothesis of evolution.

ARNOLD LUNN

The Athenaeum

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I

CAUSES OF EVOLUTION

DEAR DEWAR,

Well, as the saying is, here we are again. We are indebted to Lunn for finding us a publisher, in spite of war-time difficulties, and have agreed to revise our work so as to make it more easily understood by the plain blunt man. We are also indebted to Lunn for an introduction, the consideration of which will take the greater part of this letter.

This revision involves extra work on my part which I did not anticipate; still, on the whole, I think it worth while. I have considerable sympathy with minority views, as in many things I am in a minority myself. I believe in free discussion. If anyone has anything to say contrary to the general opinion, let him say it; let him publish it; discuss it fairly; accept it or reject it according to its value. If therefore anyone says there is an arguable case against the majority view, and can show *prima facie* evidence that there is more in it than old-fashioned prejudice, I am willing to discuss it. In the case of evolution there has always been a minority of some importance who are hostile or doubtful, and I think therefore that something is to be gained by discussing it once more.

At the same time it seems to me that there is too much of the air of grievance about Lunn's Introduction. I do not like this talk about 'foolish conspiracy' and 'conspiracy of silence.' The ordinary man of science, whose business it is to try to extend the bounds of human knowledge, cannot be expected to spend his time on what he regards as the controversies of the last century. Most of us, if we are so disposed, can formulate grievances; indeed I could make out a very good case myself. But generally speaking it does very little good to advertise grievances, real or imaginary, and, now the question has been raised, I feel it incumbent on me to say that, in my opinion, the grievances of the anti-evolutionists are mainly imaginary. In particular it does not seem to me fair or just to speak on the one hand of a conspiracy of silence, and on the other hand to speak of evolutionists 'being unable to leave his

book unanswered.' I know of no compelling reason why Dr. Morley Davies should write a reply except that he thought it a reasonable thing to do; nor is there any compelling reason why I should take part in this discussion except that I like to do so. I will put the whole matter in a nutshell by saying that, if there is a grievance, I am doing my best to remedy it, but must dissociate myself at the outset from any attacks on those who do not feel called upon to enter into controversy. I trust that I shall be allowed for the remainder of this book to discuss the question of evolution without anything further of this nature, which embarrasses me, as I hardly know whether to answer it or not.

All the same I have pleasure in accepting Lunn's invitation to continue and revise this discussion. You have difficulties about evolution. You have written two books to say so. I am aware of them in a general way, though you may spring a few new ones on me, and I do not agree with your conclusions. If you will state your difficulties clearly, each one in its appropriate chapter, and not too many of them, I will do my best to answer them, and if I cannot answer them I will say so. With the rest of the space at my disposal I will do my best to state the general case for evolution. I wish it to be understood, however, that the fact that I am undertaking this discussion does not imply the slightest doubt in my own mind that the case for evolution is sound. First of all I must devote some space to the questions raised by Lunn in his introduction.

Lunn's views are well known, and he has made no attempt to write an impartial introduction. I make no complaint, but, needless to say, I have to deal faithfully with what he says. As I have already said, I agree with him that there always has been a minority opposed to evolution, and there is still. It *is* a minority, and I do not wish to be drawn into any discussion about its size and importance; but will merely remark that the fact that I am taking part in this discussion indicates that I think it of sufficient importance to deserve serious notice. Apart from that I disagree with most of what he says and have now to say so. As he will not appear again in the discussion, you must consult with him and answer for him if necessary. He takes us into deep philosophical waters, and I agree that evolution is as much a philosophical question as a scientific one.

I will not trouble much with his history of the question. He underestimates the importance of Darwin. When an idea is in the air, it is often a matter of chance which exponent is most successful

in convincing the public. Darwin's success, in my opinion, was not due so much to his use of the concept natural selection, as to the enormous mass of material from all branches of biology, embryology and geology which he correlated, and showed how they all pointed to the same conclusion. Spencer, Huxley and Wallace all did their share, and perhaps in some ways were greater men, but Darwin actually succeeded more than the others, and it is merely foolish to try to deprecate him. But this is a side issue and does not matter greatly.

I will now try to clear up the tangle about evolution, creation and special creation. I think the majority of philosophers look back to creation in some form. At the present time this is true of the physicists. All physicists use the concept of entropy. Whenever they use it in any extensive sense they are postulating creation, for the concept of entropy definitely implies an *irreversible process*, and an irreversible process, however long it may take, looks back to a beginning and looks forward to an end. Personally I am not at all satisfied with the soundness of this concept, and have even succeeded in publishing an article against it,[1] but there it is, and it is a generally accepted idea. The physicist, however, who believes in entropy, will not expect a miracle to happen when he is working with a piece of copper, and find that it has assumed the properties of lead. Nor, when he finds a deposit of mineral formed (say) a thousand million years ago, will he admit the hypothesis that the mineral got there by a miraculous process. He looks for the natural causes, which, by the way, are exceedingly obscure. He accepts creation, but not *special creation*. Similarly the evolutionist may or may not believe in creation, but he certainly will not accept special creation.

That is why special creation is called unscientific. Lunn defines science as knowledge. That is the mediaeval use of the term. You will find it explained at length in Froude's famous essay on the relation between natural science and general science. Now, however, the meaning of the terms has changed, and it is no use squabbling about that ; it is far better to use the current terminology. Science to-day means knowledge of the natural order—that is it corresponds to Froude's natural science. General science now means a certain method of approach in education. The science in Lunn's sense which is not included in natural science is now called metaphysics, or if you like the study of final causes. This does

[1] *Oxford and Cambridge Review*, January 1912.

not matter so far as you are concerned. I shall not shirk a metaphysical discussion. If you think you have evidence for special creation, by all means bring it forward. But what it amounts to, if it is brought forward, is the claim that something has occurred outside the scope of science which science cannot explain. If we are to make ourselves understood we really must use terms in the ordinary accepted sense, and to squabble about the meaning of terms gets us no further. Whether it is science or metaphysics does not matter. Whatever you have to say, I will do my best to answer it.

You, I understand, believe in special creation; at least you have written a book entitled *Man a Special Creation.* This I suppose implies that you regard man as *one* special creation. I must ask you to be quite explicit about this, as it will be relevant when we discuss the origin of man. What are the others? What was created and when and where? What sort of evidence (apart from geology) do you think will enable us to distinguish between evolution and special creation? Lunn, on the other hand, adopts what he calls the agnostic attitude, by which I think he means that he does not know whether living organisms were formed by evolution or by special creation. There is only one answer to this attitude and that is to keep on piling on the evidence. When the evidence becomes sufficient depends on the individual. There comes a time when this attitude becomes unreasonable. I might express a doubt whether the object causing the explosion which broke the windows of the room in which I am sitting was a bomb or a meteor. Both are possible. Either would account for the effect. But I doubt whether anyone would take the second suggestion seriously. One other question on this matter—are there any other possibilities? Is there any other theory which can be stated in plain English and which is worthy of consideration? Otherwise we are limited to the alternatives evolution or special creation, or must take refuge in the statement that the whole matter is an unfathomable mystery.

Lunn deals with this to some extent, and it is necessary for me to point out his inconsistency and confusion of thought. He has put forward a number of premises, most of which can be allowed to pass without comment. You can formulate your thought under these headings, or under other headings, and it does not matter much. But if you put forward inconsistent premises, the result is inextricable confusion. This is shown most clearly in the contradiction between his premise 4 and his premise 6. Premise 4 :—'We

must not accept a miraculous explanation of any phenomenon before we have examined all possible explanations in terms of natural causes'—I accept unreservedly. That way of putting it will suit me as well as any other, and I hope it will suit you too. I must add to it the obvious statement that special creation is 'a miraculous explanation,' or, to put it more correctly, the postulation of miracles. According to the premise I have accepted, therefore, all natural explanations, especially evolution, must be exhausted before we consider seriously anything of the kind. Very well; but in that case the so-called ambi-neuter postulate does not apply. 'Facts which are equally consistent with both of two rival theories can be cited in support of neither of those theories.' Yes, if the theories are both scientific, and both on the same level. But if one of them is a theory of miracles, *it does not apply at all.* Special creation, according to our agreed premise, or any disguised form of special creation, cannot be admitted as a rival theory. There is nothing 'ambi-neuter' about it. The only argument that can be admitted for special creation is that natural causes are unable to account for the facts. If you are going to assert your premise 4, then you must apply it, and you must not try to get out of it by saying 'evolution and special creation are hypotheses' and 'we must clearly not cite facts which are equally consistent with both.' On our agreed premise special creation is not admitted as an equal and rival hypothesis. If the evidence is explicable by either evolution or special creation, then it is evidence for evolution.

Lunn gives a good example of this principle in his answer to the suggestion that a stray dog has been specially created. He remarks 'probabilities are the guide of life.' Exactly, I agree; and I give the same answer to the same suggestion concerning the animal whose fossil bones are found in the Cretaceous. But all through this introduction we have the contrary assumption. Later on Lunn argues that the finding of an intermediate type is not valid evidence for evolution because it might have been specially created. It is, I suppose theoretically possible that the type might have been specially created, but what has become of our premise? The intermediate types *are* evidence for evolution. They give evidence that it is superfluous to invoke the miraculous. Otherwise it is necessary to admit that it is equally probable that the stray dog was specially created as that it was born in the ordinary natural way. I apply exactly the same standard to the past that I do to the present. If the evidence is strong enough, Lunn's assertion is

open to the objection he quotes from Kingsley about Gosse, that what is implied is that the Almighty has created a tremendous lie. These retorts, like curses, have a way of coming home to roost.

There is much in Lunn's Introduction which I cannot deal with at length. In particular I shall ignore his quotations. We have agreed that there is a sufficient minority opposing evolution to make this book desirable. I would remark, however, that quotations taken out of their context sometimes give a false impression ; but if any of those quoted are aggrieved they must see to the matter themselves. What is more important is that a number of statements of fact quoted by Lunn, especially those concerning the geologic record, though they might have been reasonable at the time they were written, could not have been made now by competent geologists. Some of the statements Lunn makes on his own are misleading. The reader should be left in no doubt that *new species have now been formed.* This has been done with some plants, and the new species are fertile among themselves but infertile with the parent species. This is known as polyploidy ; but you do not alter a fact by giving it a long name. And even with regard to the animal kingdom, which is all Lunn asserts, the statement is doubtful. We will discuss this in the appropriate chapter. Again, I never heard of anyone who postulated the spontaneous generation of anything that could rightfully be called an organism, a term which implies a highly evolved and specialised form of life. I shall say a word or two on this later.

With regard to atheistic evolution and deistic evolution[1] I have very little to say. The point I am concerned with is that *evolution* has occurred. Lydekker is as good an example as any of the deistic evolutionist. The final sentence in his book on the horse is as follows :

> 'That these marvellous changes and adaptations are not due to any mere "blind struggle for existence" or "survival of the fittest" but that they were directly designed and controlled by an Omniscient and Omnipotent Creator is the settled and final opinion of the author of this volume.'

This admirable sentence is an assertion of *religious* belief, and should be respected as such, but it is religious, not scientific, and I am sure Lydekker would have admitted that it does not arise

[1] So far as I understand Lunn's theistic evolution, it is a variable mixture of evolution and special creation, and so need not be considered separately.

directly from the facts. So far as this discussion is concerned I regard it as irrelevant. There is no doubt that organisms vary, and that, *on the whole*, the types best fitted to the environment survive. Personally I believe that the sort of variations which actually occur are sufficient to account for evolutionary change. If so you can explain them how you like. Nor do I intend to enter into any discussion of the physical causes of the changes. Personally I believe in a small factor of use inheritance, inappreciable in a single generation, but an important factor if extended over a long time. I say this so that you may know where I stand, but I do not intend to argue about it, or try to prove it. We will try to get this preliminary matter out of the way in this chapter, so as to get on to the real discussion. I should also like to say that I mean by chance variation, if I happen to use the term, variation or variations *of which the cause is unknown*. People have a way of giving a metaphysical meaning to chance which is quite illegitimate. I mean by a chance event, not one without a cause, but one of which I am unable to disentangle the causes. This I think is sufficient on the causes of evolution. The one thing I am stating somewhat positively is that the sort of variations that have been observed is all that is needed, and that it is quite superfluous to postulate any enormous variations, though considerable variations, greater than are usual, do occur from time to time.

Most of the special questions raised by Lunn, as for example 'true lineage of fossils' I shall defer to the appropriate chapters, but one or two I had better mention now. He suggests that I should welcome the appeal to the geologic record, instead of saying that it is fragmentary. I do both. The geologic record *does* give powerful evidence for evolution, and the record *is* fragmentary. Both are facts and easily provable. But obviously what you expect from the record depends on whether or no you think it reasonably complete. We will discuss this in the appropriate chapter.

Now I had better deal with Lunn's special difficulties, which he has numbered for my benefit.

He begins with a number of general remarks asking me to find a *vera causa* for the origin of life and for evolutionary change. I am dealing later with the origin of life; but it can be briefly summarised in the expression: I don't know. And the same applies to a considerable extent to the process of evolution. What I think is not clearly understood is that the term and idea of *vera causa* belongs to a metaphysical system which is not now usually accepted,

and is not a scientific question at all. Science is unable and *does not even attempt to give a vera causa of anything*. If a stone falls to the ground, we explain it (in a sense) by the law of gravitation. But this is not a *vera causa*. The law of gravitation is a short and convenient expression of the way matter behaves. It is a *description*, and not in the metaphysical sense an explanation. No one knows *why* one particle of matter attracts another. Nor is the recent 'explanation' in terms of relativity anything more than another form of description. With regard to evolution, I have stated that I think that the kind and size of the variations *that are actually observed to occur* are sufficient. The reason for these variations is obscure. This is not 'agnosticism,' it is merely a statement of the present condition of human knowledge. As science advances, we shall no doubt know more about the conditions under which these variations occur. In the scientific sense this amounts to discovering the causes ; *but not in the metaphysical sense*. I cannot imagine an extension of knowledge which will take us beyond the stage that has been reached in the case of gravitation, or, in other words, how we can possibly get down to a *vera causa* in Lunn's sense. In any case it is so far beyond the present state of knowledge that we need not trouble with it in this discussion.

Now we can deal with the particular questions :

1. The difficulty is not at all clear. I do not know what is meant by calling natural selection a negative process. How can a process be negative, or positive either for that matter? Lunn repeats his favourite phrase of 'mud, slime, mist, sands, sea etc.' I think life is generally supposed to have originated in the sea. If Lunn wishes to contend that natural forces are unable to account for the origin of life, that is a personal opinion to which he is quite welcome. Personally I do not know enough about 'natural forces' to assert even that. I think the other points have been dealt with already.

2. I must protest against the dragging in of the names of prominent philosophers and others without references. As Whitehead is mentioned, it is just as well to say that I have no reason to think he has any doubt about the occurrence of evolution. I would say also that Whitehead, even more than most writers, needs to be read in the context to find the purpose and meaning of what he is saying. In this case, as there is no reference, I cannot do that, and in any case I am discussing this matter with you and Lunn and not with Whitehead. Moreover, even if Lunn had read the

book (which I think he has not) I should not be at all confident that he had correctly understood the meaning. At any rate he has attributed to me the acceptance of a distinction between major and minor evolution (or macro-evolution and micro-evolution) which I repudiate as artificial and unnecessary. In the present context I cannot make much sense of this Whitehead-Blyton-Lunn difficulty.

'The phrase survival of the fittest offers no explanation' of what? If it means of the origin of life, of course it does not; no one thinks it does. It does not seem to me to make sense if we confuse such different concepts as the time of existence of a rock and the biological survival of an organism. As we deal with different forms and aspects of existing things we use different concepts to try to understand them, and no sense arises if we mix them. 'Why should the trend of evolution be upwards so that higher and higher types are evolved?' I am not prepared to say offhand whether the trend of evolution is upwards or not, and I should require upward and higher types to be defined. Because higher types are evolved it does not follow that the trend of evolution is towards those higher types. The term environment is meaningless unless we go into detail. There is no environment in general, though there are many environments in particular. We can only say that the lower types are adapted to certain environments and the higher types to others.

What all this amounts to is that I do not know what Whitehead is driving at, and could only find out by reading the passage in the context. Then I have no doubt that it would be interesting and intelligible. But it makes no sense that I can discover in this context.

3. This is a very old difficulty, which will probably recur in our discussion. The way it is put begs the question. Personally I do not think that any such changes have taken place. In other words I think the changes in their rudimentary stages *are* advantageous, though I cannot undertake to explain in every case exactly how and why. There is a possible exception if the change happens to be correlated with others which are advantageous, but I do not think this possibility probable enough to be important.

The one Lunn mentions about feathers arising from scales is not as difficult as some. I regard feathers not *in the first place* as an adaptation to flight—as the bats manage very well without them—but as an adaptation giving extra warmth. The prolongation

of scales and their splitting up into fibres obviously provides protection against cold even in rudimentary stages. Lunn will get the idea if he will examine the feathers on newly hatched birds, some of which, e.g., those of a pigeon, are very simple indeed.

4. One part of this difficulty deals with the apparent suddenness with which types appear in the geologic record. I note the use of the word apparent, and that is the subject of our next two chapters.

The rest of the question concerns a difficulty stated and answered by Darwin. I deprecate being asked to explain other peoples' expositions, even Darwin's. I will therefore only say that as Darwin takes half a chapter to deal with the difficulty, there is not much sense in taking out one passage and saying that it is the explanation.

If I may be allowed to leave Darwin out of it and say a word or two on my own, I would remark that we do as a matter of fact find many transitional types. When we find them we call them varieties, but varieties and species grade into each other in such a way as to make it often an academic question which is which.

5. In living organisms there are many grades between the primitive sensitiveness to light of (say) the anterior segment of an earthworm and the human eye, and in extinct animals probably very many more. Lunn will find some of them listed in the *Science of Life* (1938 popular edition pp. 1022 seq.). The eye did not come into existence suddenly or perfect. It has been evolving for hundreds of millions of years.

6. This last question is a good one. One difficulty is that it assumes the existence of consciousness. Here we are lost. We know nothing about the origin of consciousness. Most of the functions of organisms, including our own, are unconscious. And then somehow comes this consciousness, which is *sua generis*. I do not know, neither does anyone else, how to get consciousness out of anything else. You must understand, because we accept the plain evidence for evolution, it does not mean we can explain everything. Granted the consciousness, the sensations of pleasure and pain obviously have survival value. But I can't explain in every case why one thing gives pleasure and another pain. Usually it is obvious, but there are puzzles. This is one of them. The snow peaks as islands in a sea of cloud which I once saw was perhaps the most moving sight I ever remember. Why I have not the least idea. It is, however, a fact that this feeling, so far as we know, is a modern development. So far as I know it hardly occurs in ancient literature.

Indeed it seems to be eastern rather than western. Certainly it has developed exceedingly in the last few centuries, consequently, good as the example is, as we know it has developed recently, it has not much bearing on the problems of evolution.

I want to say a few words about questions in general, as I expect that later on you will ask me a number. I wish, if I can, to get to the root of this anti-evolutionary feeling. So far as putting questions out of order is concerned, Lunn has the excuse that he will now disappear from the discussion, and leave the anti-evolutionary case to you. Therefore he must say what he has to say at once. In your case I will ask that you state your difficulties under the agreed chapter headings, and in particular that in this chapter you will discuss only questions of a general nature. I also deprecate the mixing of difficulties with quotations from other people. If this is done the question arises whether the other person has been properly understood. Also do not ask leading questions, such as question 3. It does not help reasonable discussion to ask me to explain a thing which I think does not exist. Also I would ask you in every case to make it clear how the question or difficulty is relevant to the problem of evolution. I am making these remarks in view of the 'original correspondence.' It is no use, for example, asking me why the organs of a star fish are arranged radially. In the first place I don't know, and, what is more important, I do not see what it has to do with the matter. The statement that the forms of life have been formed by the process of evolution merely gives us one clue to the unravelling of the enormous complexity of living things. It does not mean that everything is clearly explained. To put it in mathematical terms, it is one equation where there are many unknowns.

All this gives me very little space to say anything about the case for evolution, and I defer detailed evidence to the appropriate chapters. One thing I think which needs to be clearly stated in the first place is the manner in which the idea of evolution naturally arises immediately we extend the scale of time. For many centuries the progress of human thought in these matters was inhibited because everyone took the first chapter of Genesis, if not absolutely literally, at least as absolutely true in the descriptive sense. A very large section thought that the world was created 6,000 years ago, or approximately so. If that were so, it was obvious that organisms had not had time to change much, and that the forms of life that were created were very like those we now know. Cats gave

birth to kittens, dogs to puppies, cows to calves. No special creation was required; everything was referred back to the original creation. Immediately you extend the scale of time, the matter is altered. That a succession of small variations could produce cats and tigers from the same ancestral form, or horses and asses, or indeed the whole animal and vegetable world, all depends on the necessary time being available. Even Darwin felt embarrassed by Lord Kelvin's very dogmatic and entirely erroneous assertion that the history of the Earth was limited to 100 millions of years or less.

This question of the scale of time is still important. It needs no elaboration that the 6,000 years which the early interpreters of Genesis assumed is now abandoned, and even 6 millions of years is absurdly small, but there may be some difference of opinion if we try to assess the time more exactly. The results generally accepted amongst geologists, and among those who have analysed radioactive minerals, for the time that has elapsed since the Lower Cambrian is of the order of 500 millions of years. This is a matter which I studied in detail some years ago,[1] and a number of my papers will be found in scientific journals. My own opinion is that this is an underestimate, and I will not now trouble to say by how much, but that it represents correctly the *order* of the time. For the purpose of this discussion only the order of the time is relevant. In any assertion I may make about geologic time I shall use Holmes' figures. I believe that you regard them as an over-estimate. That, within reasonable limits, does not matter either; indeed I do not think any argument I shall use in these letters will be appreciably affected if you reduce Holmes' figures by 50 per cent. Still, of course, in discussing evolutionary changes, the time element has some relevance. If, however, for the sake of argument, you are prepared to accept the current estimates as sound within the limits of 50 per cent, I need say very little more about it. Otherwise, of course, the question will need further elaboration, and I shall have to give it some attention in the next chapter.

Granted the scale of time, I will now put the principle of evolution in a form slightly different from that which is customary. You will remember that at the beginning of the last century it was commonly thought that maggots arose spontaneously in decaying meat; and still later that bacteria arose spontaneously in (say) an infusion of hay. Pasteur definitely settled this question. He proved that these

[1] See particularly *Journal of Geology*, Feb.–March 1910, and *Science Progress*, Oct. 1913 and July 1914. Holmes' latest figures will be found in his *Physical Geology*, p. 104.

forms of life all arose in a natural way from pre-existing forms. That is the principle of evolution. It extends Pasteur's principle from the present day to the very beginning. All through the ages life has been formed from pre-existing life, *and from no other source.* In the many millions of years there have been vast changes. Many forms of life have become extinct. Yet always some have remained and have given rise to others which have taken their place. The principle of evolution asserts that these new forms are descended directly by the ordinary processes of reproduction and change from some of the pre-existing forms.

I had better mention here a question which I am sure will arise, and which any anti-evolutionist is likely to use. The difficulty is that of credibility. There is such an enormous difference between the higher forms of life and the lower ones that it does seem at first sight incredible that the one should have arisen from the latter, or from anything like it, by the usual process of small variations. I grant that surface appearance of incredibility, but what I wish to point out is that this is a feature of all the greater conclusions of scientific research. I take a small telescope and look at that formless glow which is called the Great Nebula in Andromeda. By a process of reasoning which the plain blunt man can follow in some detail it is shown that it is so far off that the light takes about 800,000 years to reach us, and the light in question travels at the rate of 186,000 miles a second. How vastly incredible! Mr. Bernard Shaw in one of his characteristic semi-humorous passages described it as a stupendous lie. Yet we all accept it as true. Again, when we find that a formation of mountain limestone is a thousand feet thick, or often more, and we are told that it was all formed at the bottom of the sea by the slow accumulation of the skeletons of minute animalcules similar to those which to-day inhabit the ocean. How incredible! Yet we all accept it as true. Similarly that these stupendous changes in the forms of life have occurred by small variations is on the surface incredible. An anti-evolutionist may well say that they are impossible. Yet the majority of people competent in science accept it as true. That is the point we are discussing in this book. We have to decide on the balance of the evidence the details of which must be left to the succeeding chapters. I simply wish to point out that the apparent surface incredibility is not a valid argument.

But, you may ask, what about the origin of life? Life was not possible until the earth was sufficiently cooled down. Do you

not want a special creation here? My answer is that, if you wish to postulate this, there is not at present sufficient convincing evidence against it. I will not argue the matter at length, but personally I do not think the assumption necessary. Note my manner of approaching the question, for which the reasons have already been given. The natural formation of the beginnings of life is not so incredible now as it appeared 50 years ago. I will say in the first place that I do not believe in the spontaneous generation of anything so complicated as an amoeba, or even as a bacterium; nor do I know of anyone who does. But recently the photo-microscope using ultra-violet rays, and still more recently the electron microscope, which is still in its initial phases, have taken us much farther back. Similarly bio-chemistry has taken us farther forward. I fully expect that these two lines of research will eventually meet. As things are, we know that there are forms of life very much simpler than an amoeba or a bacterium. The bacteriophages are good examples. It is really now becoming an academic question whether certain forms are alive or not. One example is snake venom. It works as if it contained harmful bacteria, and can be countered in the same way by inoculating with the suitable anti-toxin. But no bacteria have been found, and I really do not know whether the active principle is alive or not. I think the general view is that it is not alive, but the properties of living and non-living do grade into each other in a surprising way. A gradual primitive evolution rising into rudimentary life is therefore not wholly impossible. I accept it as the most probable assumption, but shall not quarrel with you if in this place you care to make the other assumption, as I know as well as you do that my own assumption is a long way from definite proof.

This is hardly relevant to our discussion, which does not include the origin of life. But it does give rise to the relevant question whether the evolution of primitive life into a definite cell with a nucleus occurred once or more than once. Needless to say I cannot answer this, though I think the probability is once only. On the other hand the world is a big place, and the time is long, and it is just possible that it occurred more than once. If so we have to admit the possibility that all the phyla are not genetically related, except in so far as they all arise from primitive non-cellular life. I regard that as a remote speculation and improbable, indeed as a rule I should not regard the suggestion seriously. Yet it does envisage the possibility of polyphyletic evolution, in a sense. I wish you

therefore to notice that in admitting this possibility, I am doing so only in this sense and am not postulating any special creations. This will not arise often in the discussion, as very seldom shall I deal with the relations between the phyla. It will be quite sufficient if we can show the great probability (please note that philosophically all scientific conclusions of any complexity must be stated in these terms) of the common origin of all the diverse forms of each of the great phyla.

The next question that arises is what kind of proof can I offer of all this. Obviously it is what Lunn calls persuasive proof. I have no time machine, and cannot take you back to the old Triassic shore, nor can I go myself. I cannot bring you back again slowly through the ages, and show you that in all times the world moved much in the same way as it does to-day, and that the rabbits always came in the natural way out of the body of the mother, and never out of the hat. It is only thus that you could find coercive proof that your special creation is a delusion and that the world moved always as at present by natural laws.

In the place of a comparatively recent creation, we have a world existing through vast eras of time. Sea and land, tide and storm, day and night, go back to a vast antiquity. But though physical conditions have remained much the same, the forms of life have altered. If we go back only a small fraction of the time shown by the study of the rocks, most of the species we know to-day are no longer to be found. There were no men, no horses, no cattle, no lions—none of the higher animals now existing. The animal life is that of a very different world. But it is not entirely different. Though our present horses are not to be found, animals somewhat similar existed having three toes. Although there were neither tigers nor cattle similar to those now living, there were mammals adapted to vegetable feeding, and others which from their structure were clearly adapted to prey on their fellows. In some of the less highly developed forms of life: crustacea, foraminifera, and others, the similarity was still more striking. The old world was different, but there were great similarities. The life in two successive epochs is much more similar than that in epochs farther apart. Some forms of life flourish, others become extinct. But those that remain and those that become abundant always bear striking resemblances to some of those that existed previously.

Our hypothesis, therefore, is that of the continuity of life. The forms of life in any epoch are directly descended from *some* of the

forms in the previous one. The evidence must be left for the succeeding chapters. As I have already stated, I cannot offer you coercive proof, but merely persuasive proof. It is a large subject, and only those with a broad philosophic outlook can appreciate and co-ordinate the evidence from so many different lines of thought. It may be that some who accept evolution do so in a mechanical way, and have not fully grasped the intricacy of the subject. Lunn's quotation from Professor Watson, which I happen to have traced to its source, is a case in point. It certainly appears to me that the statement that evolution cannot 'be proved by logically coherent evidence to be true' shows a lack of appreciation of the methods of scientific reasoning. I am getting a little bored by that quotation, which I have heard much too often, but I think, in the context, where it is not properly explained, it does show the deficiency I have mentioned. As some of my special work has been the study of the type of reasoning used in scientific work, and especially in the larger questions such as these, I may perhaps be able now and again to show where you reason in the wrong way. The problem of the canons of scientific reasoning is equally interesting whether we are dealing with correct reasoning or incorrect. We shall not as a rule quarrel about the facts, and I have no doubt whatever about your competence in collecting these. Certainly you know more of the facts of natural history than I do. You have also been collecting facts and arguments on this matter for some years, which I have not. You have the advantage of an introduction[1] which is definitely on your side, and of Lunn's help throughout the discussion. I am willing that you should have these advantages, because I am convinced that your reasoning is fundamentally unsound.

One final word on the subject of authorities. Lunn has saved you the trouble of showing that there is a minority which agrees with you. We need not quarrel about the size and importance of that minority. If we are arguing from authority you have lost the case from the beginning. I shall refer to authorities only for facts. There we *must* rely on authority, because no one can personally be acquainted with all the facts concerned. But I do not propose to refer to authorities on opinions, or on methods of reasoning, and I hope you will follow the same rule. On this question I am discussing the question with you, and I do not wish to be obliged to make depreciatory remarks on any others who may happen to

[1] Since this was written, Lunn has informed me that on this account I am allowed a little extra space, which concession is thankfully accepted.

agree with you. That the great majority of scientific opinion is on my side is irrelevant, and I shall not mention it again—unless you force me to do so. Similarly it is quite unnecessary to add to Lunn's quotations. I am not sheltering myself behind Darwin, Spencer, Huxley, Wallace, and their successors too numerous to mention. I am expressing the evidence in my own way, and I hope you will do the same.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

In connection with your comments on Lunn's introduction I here quote a letter I have received from him :

'Shelton writes : "As Lunn will not appear again in this discussion you must consult with him and answer for him if necessary." I have just one or two points which you should put by way of clearing things up. I know that Shelton does not accept the distinction between major and minor evolution. All I intended to imply was that he had made use of my terminology to attack what he considers an unreal distinction.

'I note that Shelton regards the geological record as reliable when it tells in his favour and too fragmentary to be of any value when it tells in your favour.

'Creation, whenever it occurred, involves miracles and I wish Shelton would explain why it is more scientific to relegate this miracle to a period before the planet was created than to admit miracles into the evolutionary process. It seems to me that the atheistic evolutionist has the advantage in logic over the deistic evolutionist.

'As to theistic evolution, the deist differs from the theist in that the former rejects and the latter accepts miracles. Deistic evolution is a purely natural process. The theistic evolutionist accepts descent of man from lower species but does not believe that purely natural forces are sufficient to explain evolution. At various stages in the process mutations, inexplicable solely in terms of natural agencies, must be postulated. I am not myself a theistic evolutionist but an agnostic so far as all evolutionary theories are concerned.

'With regard to premise 4. I am, of course, ready to examine any theory of evolution and to accept it, if proved, and to give such theories priority over special creation, but I am not prepared to

admit the arrogant claim that "special creation cannot be admitted as a rival theory." It is, of course, a very respectable rival for reasons already set out in my introduction. And unless Shelton can produce some more convincing explanation of the causes and mechanism of evolution, the unbiased reader will have to choose between special creation, theistic creation or agnosticism.

'It argues a certain lack of confidence in his case that he has to begin by attempting to rig the laws of evidence in favour of evolution. Consider, for instance, his remark "if the evidence is explicable by either evolution or special creation then it is evidence for evolution." Dewar is the counsel for special creation. "Gentlemen of the jury," says Shelton, "there is a good deal of evidence in this case which is equally easy to reconcile with my case and with my learned friend's case. All such evidence must be treated as if it told only in favour of my case." I have read for and you have practised at the Bar, and we both know the kind of comments which a judge would pass on such a claim.

' "I may perhaps," Shelton writes, "be able to show you where you reason in the wrong way." Perhaps, but it is by no means excluded that you may be able to perform the same kind service for Shelton.

'Shelton's attempt to restrict the word "scientific" to explanations in terms of natural forces would not be accepted by such scientists as have investigated psychical phenomena. He often quotes from *The Science of Life*. He will, I think, find in that book a discussion of psychical phenomena which the authors admit to be worthy of investigation. The scientist begins, of course, by attempting to explain these phenomena in terms of natural forces, but he does not begin his investigation with a closed mind. He does not rule out in advance the possibility that these phenomena might be caused by supernatural (or praeternatural) agencies. Nothing could be less scientific than to exclude from the field of research any possible explanation of the phenomena under investigation. In the case of psychical phenomena, as in the case of evolution, we begin by trying to exhaust natural causes, but *priority of investigation does not imply that the ordinary rules of evidence can be violated in favour of the hypothesis with which we begin our investigation.* The fact that we must *begin* by examining hypothesis A before considering hypothesis B does not mean that A is more likely to be true than B. Le Verriere *began* by trying to explain the movements of planets on the hypothesis that there were no new planets to discover.

After proving that hypothesis A did not fit the facts he proceeded to hypothesis B and discovered the planet Uranus.

'I am beginning to think that my agnosticism about evolution only differs from Shelton's in degree. He does not explain (1) the origin of life, (2) the upward trend of evolution, (3) why the process should ever have started, (4) how the variations originated which are the raw material for evolution, (5) how natural selection which only selects what is there could possibly be creative, (6) how pure chance could produce so complex an organ as the eye, (7) how variations in their rudimentary form could be advantageous, (8) how the sense of beauty originated. Shelton picks out our feeling for mountains and asserts because "it has developed recently, it has not much bearing on evolution." Has the evolutionary process ceased? I wish you would ask him. Of course man's sense of beauty was present from the first, witness prehistoric paintings.

'One word more. The publishers commissioned this book on the distinct understanding that its thesis was "Is Evolution Proved?" Shelton must therefore prove his case, not disprove yours. He must not follow the bad precedent of Watson and others of assuming that depreciatory remarks about special creation are an adequate substitute for proof of evolution. You, for your part, are only concerned in this book to disprove evolution, and though the creationist hypothesis may be mentioned from time to time, it is no part of your case to prove special creation. Many but not all those readers whom Shelton fails to convince will be converted to special creation. Some will, perhaps, agree with me, that the evidence is insufficient to warrant us accepting either special creation or evolution.'

. . . . .

In the event of your making any comments on Lunn's letter that seem to require a reply, I will do my best to give the reply.

In connection with your answers to Lunn's questions in the introduction :

You have not attempted to tackle the problem that baffled Darwin (*Origin of Species* (1882 ed.), p. 133), viz., if evolution be true we should expect to see (a) innumerable transitional forms. (Note the word 'innumerable,' and that the transitional forms are between *species*), (b) 'all nature in confusion.' Instead of this (c) species, as we see them, are sharply defined. This you can easily see by looking at the plants growing on any piece of uncultivated ground. If all

nature were in confusion and species, genera, families, orders and classes were not sharply defined, but faded into one another, this could be adduced as evidence in favour of evolution. Of the above points you ignore (b) and (c), and try to avoid (a) by citing varieties within species as transitional forms, but these are as easy to reconcile with creationism as with evolution. Citing as evidence for evolution facts easily explicable on the theory of special creation will not get you far. In view of this I request you to comment on (a), (b) and (c) above.

In reply to Lunn's remarks about feathers you say you regard these as an adaptation to giving extra warmth, but you completely ignore Lunn's main difficulty, viz., how a bird became a flier. The immensely complicated structure of feathers (some of which are said to contain more than a million barbules) is not necessary if their function is only to assist in the retention of body heat. You make no attempt to explain how the fore-leg of a reptile became *gradually* converted into the wing of a bird—an implement that in a fraction of a second can be changed from a surface impervious to air into one through which air passes almost without resistance. This is but one of many gradual changes, or rather transformations, postulated by the evolution theory, which I believe to be impossible. One of the reasons why I reject the evolution theory is that it demands impossible changes. In my view the first flying bird was a special creation, i.e. it originated suddenly, *per saltum*, whether by the transformation of some other animal or otherwise is, I think, beyond the power of science to discover. Bear in mind that the change of an ambulatory or swimming leg into a bird's wing would, *inter alia*, necessitate the rearrangement of almost every bone and muscle in the body. It is up to you to explain how all these changes can have been effected by the accumulation of small variations. When we discuss the morphological difficulties of the evolution theory I shall ask you to say how you imagine this transformation took place.

As to Lunn's point No. 5 : How do you explain the evolution of very complex organs such as an eye? Your reply that there are many grades between the primitive sensitiveness to light of the anterior segment of an earthworm and the human eye is merely an evasion of the question. Do you realise that 'a primitive sensitiveness to light' involves not only a modification of a part of the integument, but a correlated modification of the nerve supplying it and the part of the brain or ganglion at which external impressions

are received and acted on? Even if this happened, of what use is this to the animal until this is provided with some mechanism for translating this stimulus into action? What advantage has a creature having what you call this sensitiveness to light in a certain part of its body over one lacking this sensitiveness? What do you imagine caused this supposed modification of skin, nerve and ganglion?

The eye is but one of many organs which I think cannot have evolved gradually. The existence of such structures is one of the greatest objections to the evolution theory. Lunn happens to have selected as an example the eye, an organ of which there are many kinds. But this is not the case for all such organs, and, as this objection is so important, I will in a later chapter deal with one of these, the web-spinning apparatus of spiders, which I propose to discuss in detail.

You write: 'A number of statements of fact quoted by Lunn, especially those concerning the geological record, though they might have been reasonable at the time they were made, could not have been made now by competent geologists.' I have not been able to find any such statements; will you please name them.

My observations on your letter are as follows: First, as Lunn has stated, you are the plaintiff and I am the defendant and our readers are the jury. You as plaintiff claim that evolution is true and is supported by cogent evidence which you are about to produce and by means of which you hope to induce the jury to find that you have established your case. But there are a number of theories of evolution, of which only one (if any) can be true. This being so it is incumbent on you as plaintiff to state in precise terms precisely the particular theory you seek to establish. Until you have done this, the jury cannot know what we are disputing about and I cannot know what I have to attack. This you have not done. At considerable pains I have read your letter more than once in the hope of discovering precisely what your case is. My impression is that the theory of evolution most commonly propounded is that millions of years ago inorganic matter, acted upon by natural forces, gave origin to a living organism which, owing to the action of the said forces, has evolved into all living and extinct animals and plants, including man.

So far as I can make out from your letter, you are not prepared to go so far as this. You say you do not think that life was specially created. You say that Pasteur showed that bacteria all arise in a

natural way from pre-existing bacteria. 'That,' you assert, 'is the principle of evolution.' In fact, however, the evolution theory asserts that on one occasion life arose from inorganic matter, i.e. just what Pasteur, according to you, disproved! Then you admit that you cannot say whether or not 'the evolution of primitive life into a cell with a definite nucleus occurred more than once.' All this seems to me very indefinite.

You seem to be equally indefinite regarding the origin of the great groups of animals known as phyla. As regards bodily structure every animal, living and extinct, is of one or other of a few types, each fundamentally different from all the others. The structure of back-boned animals is of one type, that of molluscs of another, that of worms of a third. (See the appendix to this letter.) *One of the most difficult problems the evolutionist has to solve is how all these phyla can have evolved out of a speck of protoplasm.*

The statements you have made in your letter seem to imply: (1) For all you know the phyla may not be genetically related, but you doubt this. (2) You are little interested in the relations between the phyla. (3) 'It will be quite sufficient if we can show the great probability . . . of the common origin of all the diverse forms of each of the great phyla.' I take all this to mean that you are completely in the dark (which is true of all evolutionists) as to how, when, and where the phyla originated. But this does not matter. All you need do is to show that it is extremely probable that all the members of each phylum are derived from a common ancestor, e.g. all vertebrates from a common vertebrate ancestor, all molluscs from a common molluscan ancestor, etc. If you can do this it automatically follows that all the phyla themselves are derived from a common ancestor. Thus, in your view, proof of the lesser is proof of the greater. This is indeed an ingenious way of proving evolution. But why take so much trouble? Why not be content with showing it to be extremely probable that all the sub-species of a species are derived from a common ancestor, and extend this to genera, families, etc.?

I assert that there is not an iota of evidence, either experimental, morphological, palaeontological, embryological, or of any other kind, that the phyla evolved from a simple nucleated cell, much less from 'primitive life' or from inorganic matter. Nor is there a shred of evidence that any phylum evolved from another phylum. The vertebrata form the highest phylum, but there is no evidence that this phylum is derived from any other. *Thus the notion that the phyla evolved from 'primitive life'*

has no scientific foundation. It is, if you like, a philosophy unsupported by any kind of evidence, a pure matter of faith.

If the phyla evolved from 'a simple nucleated cell' then it follows that more than five-sixths of the sum total of evolution that has taken place since life appeared on the earth was concerned with the evolution of the first members of each phylum. Of this huge slice of evolution there is no evidence. Thus the subsequent evolution or differentiation whereby the primitive members of each phylum gave rise to all the existing forms, constitutes less than one-sixth of the earlier evolution in the case of the vertebrates and much less in the case of the other phyla. I make this distinction because, according to the evolutionist, while the fishes that remained in the sea have undergone but little modification, one enterprising fish that took to life on land became an amphibian and from this reptiles, birds and mammals evolved. Nothing approaching this has happened in the case of any of the other phyla. The protozoa, echinoderms, etc., differ but little from their Cambrian ancestors. This apparent difference in respect of modification between the vertebrata and all the other phyla seems to me to be, for the evolutionist, a problem not easy to solve.

Will you please say whether or not I have interpreted correctly your statements to which I have referred, i.e. that all that you are attempting to prove is *evolution within the phylum.* If this be not so, will you kindly state precisely what you are trying to prove. Armed with this information I shall be in a better position than I now am to take up the other points you have raised. This I will do in my next letter.

Yours sincerely,

D. DEWAR.

APPENDIX

LIST OF THE PHYLA

ONE-CELLED ANIMALS

1. Protozoa.

MULTI-CELLED ANIMALS

2. Coelenterata (jelly-fishes, corals, etc.).
3. Porifera (sponges).
4. Platyhelminthes (flat-worms, tape-worms, etc.).
5. Nemertinea (marine worms).
6. Rotifera (wheel-animalcules).
7. Nematoda (thread-worms).
8. Annelida (round worms, such as the common garden worm).

9. Arthropoda (crabs, lobsters, insects, spiders, etc.).
10. Mollusca (cuttle-fishes, limpets, snails, mussels, etc.).
11. Echinodermata (star-fishes, sea-urchins, sea-cucumbers, etc.).
12. Brachiopoda (lamp-shells).
13. Polyzoa (a large group of microscopic animals that live in colonies).
14. Chaetopoda (arrow-worms).
15. Vertebrata (back-boned animals, fishes, amphibia, reptiles, birds, mammals, also amphioxus).

DEAR DEWAR,

I will try to be brief this time. We want to get these metaphysical discussions out of the way. I am not particularly interested in this argument about Deistic Evolution and Theistic Evolution. If anyone likes to say (as Wallace did) that the evolution of man from a lower animal implies a special exercise of Divine directive power, which appears to be what Lunn means by Theistic Evolution, I am not disposed to argue the matter. It is a religious attitude, and can neither be proved nor disproved. Neither can Lyddeker's Deistic Evolution. In this discussion I am merely trying to show that man *has* been evolved from other forms of life, and in general with organic evolution. If this is admitted, I am not much concerned with metaphysical interpretations, which are conditioned by religious attitude and personal preference.

Special creation, however, is another matter. It implies the *obviously* miraculous. My objection to it as a hypothesis is that I know of no criterion by which it can either be proved or disproved. However powerful may be the evidence for evolution, it is still possible to say, if you are so disposed: Yes, in this case you have the right kind of evidence, but it is still possible that the forms were specially created. I suppose it is. To put it briefly and bluntly there is a sense in which special creation will account for anything. That being so, in another and more important sense it will account for nothing.

Your statement that the first flying bird originated suddenly, *per saltum*, 'whether by the transformation of some other animal or otherwise, is, I think, impossible for science to determine' is open to the same objection. It does, however, raise the question of the size of the variations which normally occur in living beings. As a rule these are small, but occasionally a larger one occurs. I am not prepared to dogmatise exactly how large these freak variations

may be. Nor can I dogmatically say what proportion of evolutionary change is due to small variations, and what proportion to larger ones. Personally I think the bulk of evolutionary change comes from small variations, but that is merely an opinion.

All the same there is a limit, though I shall make no attempt to draw the line exactly. I will, however, say at once that I regard as entirely out of the question anything of the size of the formation of a bird *per saltum*. If an animal in any way like a crocodile laid an egg which hatched out to anything like an eagle, that is as near to special creation as does not matter, and I reject that form of special creation as emphatically as any other form. Indeed I should be highly sceptical if I were informed of the occurrence of a much smaller change, such as the assertion that the egg of a hedge sparrow hatched out to form a cuckoo.

There are a few details which I had better deal with now. The first are what I may call your supplementaries to Lunn's difficulties, in particular the 'innumerable transitional forms.' Sometimes we get them, as for example in the West Indies there are innumerable transitional forms between the white man and the black man. But generally speaking the characters of species are *relatively* fixed, and the reason for this relative stability is fairly clear. The form of a species tends to approximate to that best fitted to the environment and mode of life. When these remain constant, so do the species. Some forms of life have not changed appreciably since Cambrian times. Evolutionary change usually occurs either when the environment changes, or as an adaptation to a new environment. I should remark, however, that variations do occur in 'fixed' species, though they are suppressed by the action of natural selection.

About this question of feathers and flyers, I must defer the detailed discussion to the appropriate chapter. If Lunn wants to know how feathers originated that is one question, and if he wants to know how the bird became a flyer that is another, and the two questions are not necessarily connected. Of course I cannot answer either, except in a speculative way. I don't know. I have given a speculative answer to the first question, and with regard to the second I can only in a speculative way refer him to the numerous living creatures with incipient flying organs : flying squirrel, flying phalanger, etc. Granting both incipient feathers and incipient flight, it is surely no very serious difficulty that the feathers should stream line, and afterwards become specially adapted to aid and improve the flight.

You ask me what I mean by saying that some of Lunn's quotations are out of date. The one I had particularly in mind was from T. H. Huxley.:

> 'In answer to the question "what does an impartial survey of the positively ascertained truths of palaeontology testify in relation to the common doctrines of progressive modification?" I reply: "it negatives these doctrines, for it either shows no evidence for such modification or demonstrates that such modification has been very slight."'

This passage first occurs in an address to the Geological Society in 1862. It is repeated in a second address to the same society in 1870, and it is from this second address that Lunn's quotation is made. It would have been instructive if he had taken the trouble to read the address through. Had he done so he would have found a number of other relevant passages, as for example: 'There is much ground for softening the somewhat Brutus-like severity with which in 1862 I dealt with a doctrine for the truth of which I should have been glad enough to be able to find a good foundation,' and 'But when we turn to the higher vertebrate the results of recent investigation, however we may sift and criticise them, seem to me to leave a clear balance in favour of the doctrine of the evolution of living forms from one another.'[1]

To put it briefly and bluntly: the very passage Lunn quotes is itself a quotation by Huxley from his previous address, and it is quoted for the express purpose of showing that then (in 1870) it is out of date. I think it will be agreed that a statement already out of date in 1870 is still more so in 1945. Also I may be excused, when I find the quotation I am able to verify is of this character, for being a little suspicious of the others which I am not able to verify.

This well illustrates what I said in my last letter that I am more interested in your arguments than in your quotations, especially when no references are given.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

May I entreat you not to attribute to me statements I have not made? I did not ask you what you meant by saying that

[1] *Collected Essays*, Volume 8, pp. 303, 342, 347, 348.

some of Lunn's quotations are out-of-date. I reproduced your words, and asked you to name such quotations, as I could not find them. You refer me to Huxley's assertion, made nearly 80 years ago, that the geological record either shows no evidence for such modification or demonstrates that such modification has been very slight.

But please note (1) Lunn quoted the passage to show that Huxley accepted evolution with enthusiasm, not because the evidence was compelling, but because he was seeking for some alternative to what he described as the 'untenable separate creation theory.' If you will pardon me for saying so, this seems to be the reason why you so enthusiastically accept evolution. I say this because, although we are discussing evolution, you again and again gird at the theory of special creation. Please bear in mind that even if evolution were proved to-morrow, the fact would still remain that Huxley, Yves Delage, Watson, and others had previously accepted it for unscientific reasons, for it is unscientific to accept a theory because of dislike of the rival theory.

(2) In any case the statement of Huxley we are considering is one which, at any rate with the omission of 'very,' can be made to-day, and statements of the kind have recently been made by competent geologists and biologists, for example, Paul Lemoine, L. Merson Davies, L. Vialleton, Austin Clark; also less than 20 years ago, by Depéret. As you object to my quoting authorities, I will refrain. But *I challenge you to cite a genetic series of fossils linking by small steps an order with another order or a family with another family.*

You have but to show such a series in order to convert Lunn to evolutionism, and to make me reconsider my attitude towards it.

You say special creation implies the obviously *miraculous*, I agree. But evolutionism implies the obviously *fabulous*, such as the gradual conversion of a reptile into a bird.

You also say 'however powerful be the evidence for evolution, it is still possible to say that the forms were specially created.' I agree, but it is equally true: 'no matter how scanty be the evidence for evolution it is possible to say that evolution is a fact.'

I am sorry, but I am compelled to challenge your statement that the patagium of the flying squirrel or of the flying phalanger is an incipient flying organ. It is nothing of the kind. It is a *gliding* organ. Please accept the correction or describe how a patagium of squirrel or phalanger could possibly be gradually transformed into the wing of a bat or of any kind of winged mammal. I am sorry

to have to contradict you so often, but if *in a debate* you make unsustainable statements you must expect to be taken up.

In conclusion, may I remind you (1) you have not yet answered Lunn's questions: What is your theory of the causes of evolution? How did the process begin? What is the mechanism which gradually transformed inorganic matter into life and which bridged the gaps between the different Families? What is the *vera causa* of evolution?

(2) You have not yet stated what you are trying to prove in this debate.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I am sorry if I misunderstood you, or Lunn, but really I find you both a little difficult to understand. I did think when I pointed out that a quotation by Lunn 'could not now be made by competent geologists' that I was answering your question. Your explanation why Lunn made the quotation at all is welcome, as it is not clear from his exposition. With regard to your further remarks on the geologic record, we will discuss all these matters in the next two chapters.

It is really necessary, however, to comment once again on your continual repetition of the view that special creation can be regarded as an equal rival theory to evolution. We have agreed (that is Lunn and I) that a 'miraculous explanation' must not be invoked until we have exhausted all known natural causes. Whether or no you agree I do not know, but if you do not you should say so. Anyhow, you both try to get out of it, and that illustrates my contention that anti-evolutionism is confusion of thought.

Let me be quite clear on this matter from the start. If you regard special creation as an equal rival hypothesis with evolution, and think it a sufficient answer, when evidence for evolution is given, to reply that the evidence is also consistent with special creation, *I have no answer to give you.* I acknowledge from the start that there is no evidence, *and I can think of no possible evidence*, which cannot be explained by special creation, if for some extraordinary reason anyone wishes to interpret things in that way. It is the stray dog over again. I cannot prove that the stray dog was not specially created. Let me illustrate the point further by a simple analogy. If anyone likes to say that the sun rises every day, not

because the earth is rotating, but by a miraculous act of the Creator, I cannot answer that either. I could give evidence that the earth *is* rotating, but that is all I could do. Similarly all through this discussion I shall give evidence that evolution *has* occurred, but again that is all I can do. If you like instead to say that the whole process is a series of miracles, that is a personal metaphysical interpretation to which no reply is possible. I cannot then prove the case for evolution *to you*. I can only prove it for those who accept the normal fundamental metaphysical assumptions.

I have nothing further to say at present about the causes of evolution. The space at my disposal is not sufficient for me to enter into such involved and intricate discussions. Moreover, as you appear to doubt whether evolution has occurred at all, the question hardly arises for you, and there is no point in discussing it until the primary question is settled. If evolution has not occurred, there are no causes. Finally, I think my remarks on the speculative question of the remote possibility of polyphyletic evolution were reasonably clear. If they are not so, I cannot make them clearer.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

It is unkind of Lunn to ask you to state what you imagine to be the causes of evolution. I would not have been so cruel, because I am convinced that evolution has not occurred, and so there is no cause of it ! But Lunn does not share this conviction, in consequence his question is a very proper one, and the fact that neither you nor any one else can answer it tells heavily against the evolution theory. Seeing that you have devoted your last letter almost entirely to special creation, which we are not debating, your excuse that want of space prevents you from answering Lunn is patently a lame one.

I agree that we ought not to invoke a miraculous explanation until we have exhausted all known natural causes. I certainly shall not do so. Your remarks about special creation in your last letter ignored my challenge to you to cite a series of fossils linking by small steps an Order with another Order, or a Family with another Family, coupled with my words '*You have but to show such a series in order to convert Lunn to evolution and to make me reconsider my attitude towards it.*'

Instead of accepting this challenge you drag in the stray dog, because neither you nor any one else can cite such a series. You continually meet argument with mere assertion. You have not made the slightest attempt to show why special creation should be ruled out of court as inadmissible. You take refuge in pretentious phrases such as 'the normal fundamental metaphysical assumptions.'

In spite of this implied claim to be more conversant with the laws of thought than I am *you are guilty of a gross confusion between two very different metaphysical conceptions* to wit *an explanation and a reasonable explanation.* There is a sense in which everything could be explained by special creation even if a true linkage series of fossils were discovered, but if each link in the series were described as a special creation that would not be a *reasonable explanation.* We all admit that animals are modifiable *within limits. The only question which divides us, a strictly scientific question, is whether such modification is limited or unlimited.*

I suppose your stray dog will come into this discussion every time you are in difficulties.

There is one significant difference between you and the older evolutionists. They realised that the *onus probandi* is on the evolutionist, that it is his job to suggest a *vera causa* of evolution and to *prove* that the agent they invoke can bridge the gaps between the Families, Orders, etc. But, as their efforts have all failed, you plead limitations of space as an excuse for no attempt to explain how evolution began and how the process continues.

At the close of my first letter I put to you a very definite question, viz.; is all that you are attempting to prove *evolution within the phylum*? The plain answer to this is either 'Yes' or 'No'. If the latter is your answer, then you should state precisely what you are going to try to prove. If you do not know what you want to prove, why not state this candidly?

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I am getting tired of this preliminary fencing, and wish to get on to the details of the discussion. Indeed, so far as this chapter is concerned, I have nothing further to say. As, however, what I have said does not appear to be understood, I had better *repeat.*

First, about the causes of evolution, I have already said that

I think that *the variations that normally occur and can be observed in living creatures are all that are required.* These, though small, in course of time add up to the changes that have actually taken place. According to the environment, and the changes in the environment, and to the movement of the organisms to other environments, some variations will survive and others be eliminated. This is usually known as natural selection.

The causes of the variations are unknown. We know they occur, but we do not know why. Personally I believe in a small feature of use-inheritance ; but that is merely a personal opinion, and of no consequence whatever.

Next you want to know what I am setting out to prove. I am not setting out to prove anything. The time for that is gone. The *onus probandi* in the year 1945 is no longer on those who accept evolution. The title of this book is :—*Is Evolution Proved*, not whether I am personally able to prove it. A few people like you and Lunn appear to think that evolution is not proven. That is an unusual attitude, and I have consented to do my best to discuss the matter with you. My contention is that evolution has been proved sufficiently to convince any reasonable person. The implication that you are not a reasonable person is unfortunate, but I can't help it. Of course I may not succeed ; but if that occurred, it would be on account of my lack of skill. I regard the matter as settled for all practical purposes.

By evolution I mean the continuity of life from primitive non-cellular life up to the present time. I am not interested in your list of phyla. The point I tried to make clear was whether the evolution of life to form a definite cellular structure occurred once or more than once. The probability is once only, but I am not dogmatic about it, and, if it occurred more than once, there would be a sense in which all living beings would not necessarily be genetically connected. Polyphyletic evolution is not a very good name for this hypothetical suggestion, but I do not know a better. The answer to your question whether I am attempting 'to prove evolution within the phyla' is yes, subject to the qualification that I am not attempting to prove anything. I give you a yes, as you seem to want it, but the question is misleading.

I note your distinction between an explanation and a reasonable explanation. You did not make that clear before, and it did not occur to me that you thought special creation an unreasonable explanation in any case. Personally I think it an unreasonable

explanation *always*. Still, in the course of the subsequent discussion, if occasions arise when you think it reasonable, and not in contradiction to the principle on which we are now all three agreed, by all means say so.

We have two chapters in which to discuss the evidence from geology, and your obvious desire to anticipate does not seem to me to be sensible. Still, as you are so insistent, I will say at once that the change from Equus to Eohippus can be traced by small steps, and the change is *considerably greater than* that usually implied by linking 'a family with another family.' You must understand of course that it is only narrow specialists who regard these terms family and order as more than mere conveniences. There is no such thing in nature as a family or an order, there are merely varying degrees of difference which we do our best to classify in the most convenient way. I say this now, but I must protest against your forcing me to deal with these matters out of order.

I wish to add also that it seems to me foolish to attach such importance to this particular point, which seems to me quite a minor one, but it does happen that there is evidence which I think gives reasonable grounds for the statement I have made. I would say farther that in my opinion both you and Lunn attach too much importance to the evidence from geology. The case for evolution would be perfectly sound if no fossils had ever been found.

Yours sincerely,

H. S. SHELTON.

2

THE GEOLOGICAL RECORD (ITS VALUE)

DEAR SHELTON,

(I) The Evidence of the Fossils.

The theory of evolution must stand or fall by the evidence of the fossils. These furnish the only *direct* evidence. If this be against the theory no amount of indirect evidence can avail.

(II) How Fossils are formed.

Fossils are the remains of, or impressions made by, animals and plants in the rocks. If an animal having a skeleton, shell, or other hard parts, be buried or covered by sediment after death before the hard parts have had time to decompose, they are likely to be preserved as fossils.

In this process they frequently undergo change by the replacement of more or less of their original material by mineral matter, such as oxide of iron. Animals lacking hard parts are much less often fossilised, and, in consequence, the fossil record of them is comparatively meagre, although they in many cases leave traces in the form of impressions made in the soil before they decay. Fossils of even jelly fish have been found. Fortunately the animals having hard parts outnumber those that lack these, in consequence the crust of the earth holds untold millions of fossils. I may here say that birds and bats, owing to their power of flight are less liable than ground animals to be drowned and buried in floods, or to be buried by falling cliffs, or to be bogged, hence their fossils, although numerous, are not so abundant as those of mammals tied to the ground. Arboreal quadrupeds are less liable to fossilisation than these last.

(III) The Alleged Imperfection of the Fossil Record.

One of the most formidable objections to the evolution theory is the fact that no fossil has been discovered of an animal intermediate between creatures having a very peculiar skeleton, such as

bats, whales, dugongs, seals, frogs, turtles, pterodactyls, ichthyosauruses, etc., and the supposed ordinary quadrupedal animals, from which, according to the theory, they have evolved. If this theory be true, these intermediate forms must have existed in immense numbers in the past. Darwin devoted a whole chapter of the *Origin of Species* to the attempt to meet this difficulty. The best he could do was to express his belief that the fossil record is 'incomparably less perfect than is usually supposed.' And so far as I am aware no later evolutionist has been able to improve on Darwin's effort. *Mirabile dictu neither Darwin nor any of his followers seems to have made any attempt to ascertain to what extent animals are fossilised.* Their attitude seems to be: The evolution theory is true; therefore these intermediate forms must have existed; as none of their fossils have been found the fossil record is exceedingly imperfect. But is not this to put the cart before the horse?

(IV) The Fossil Record is far more complete than Darwin supposed it to be, and than his followers admit.

(*a*) *Every genus of animal having a skeleton or hard parts has left fossil remains.*

This last may seem to you a rash statement, but I propose to substantiate it. It is commonly said that only about one animal in a million is fossilised. I am prepared for the sake of argument to accept this. I now ask you to consider (i) the average population of a genus (ii) the average length of time during which on an average a genus persists. As to (i), in few cases can the population of a genus be less than 3 million. In the case of some genera this average is very many million. Let us take the case of a genus of which the average population is 3 millions, and which is renewed every 20 years. This means that every century in all 15 millions of individuals of that genus have existed. As to (ii), we know that quite a number of genera of animals have existed for more than 100 million years. But let us consider a comparatively short-lived genus which exists only 5 million years. To arrive at the total number of individuals that composed this genus during the period of its existence we have to calculate the number of centuries that make up 5 million years, this is 50 thousand, and by multiplying this by 15 million, i.e., the number of individuals that lived in each century, we arrive at a total of 75 thousand million, and as one of these in each million was fossilised, the genus in question left behind it 75 thousand

fossils. Thus, unless you dispute the above figures, I think you must admit that my assertion that every genus having hard parts leaves fossil remains is a very modest one. If you dispute my figures, will you please give what you consider to be the correct figures.

Let me emphasise that my figures do not mean that I assert that some 75,000 fossils of every extinct genus of animals having hard parts now exist. I am dealing with the extent to which fossils are laid down. In considering the percentage of such fossils that still exist we have to try to discover to what extent fossiliferous rocks are destroyed in course of time. Let us do this.

(*b*) *The extent to which fossils are destroyed.*

The destruction of rocks and with them the fossils they hold has been considerable, but nothing like so great as is generally believed.

The great bulk of the destruction of rocks is due to what is known as sub-aerial denudation, that is to say by the action of wind, rain and sun, and by exposure to the air. Most of the later sedimentary rocks are formed from the material derived from the denudation of earlier fossil-bearing rocks. The amount of destruction that any particular rock has suffered depends very largely on the situation in which it is laid down. I contend that :

(i) *The destruction has been comparatively small in the case of rocks laid down in the sea. Thus the geological record is not far from complete in the case of these rocks, which constitute by far the greater part of the sedimentary rocks now existing.*

It is only when, as the result of some disturbance, rocks laid down in the sea are raised above sea level that they become subjected to sub-aerial denudation. This ceases as soon as the rocks in question again become submerged. But these elevations are local affairs, and so each means merely the destruction of a number of fossils of the local fauna, and except in cases when the range of the species and genera so destroyed is limited to the affected area, the only affect of the destruction will be a diminution of the number of the fossils preserved of the species and genera affected. Thus, taking the geological record as whole, it is not far from complete in the case of marine animals having hard parts. Marine animals, be it noted, are far more numerous than land animals.

(ii) *The destruction of land rocks has been great in the case of those laid down in the Primary Epoch, and in those laid down far from the sea and at high elevations in the Secondary Epoch.*

(iii) *The destruction of land rocks laid down in low-lying coastal*

areas has not been very great in the Secondary and Tertiary Epochs, and the fossil record of the animals and plants that inhabited such localities is fairly complete.

(iv) *In the case of all land rocks laid down in the Tertiary Epoch the destruction has not been great, and, in consequence, the fossil record of Tertiary land animals is not very far from complete. For example fossils have been found of every genus of land mammal (except bats) now living in Europe.* Details of the fossils of Tertiary mammals of which I have found records are given in the tables in the appendix of this letter. These figures are rather startling. They tell us that at some stages of the Tertiary Epoch a greater number of genera lived in Europe and North America than now inhabit these continents. They dispose of the notion that the fossil record of Tertiary mammals is very incomplete. They tell us that many genera of land mammals became extinct in the Pleistocene period, also that in that period more genera of land mammals seem to have lived on those two continents than in most of the previous periods. The recent fall in numbers seems to be the result of the last ice age. The cold drove south many northern animals and eventually killed off many organisms. The warm intervals in the glacial period also caused some southern forms to migrate into Europe and North America. Fluctuations, mostly less marked, occur in the figures for the earlier stages. Some of these may indicate climatic changes, such as dry periods unfavourable for the laying down of fossils of land animals. Most of the fossils of these occur in lacustrine beds. But probably the greater part of the fluctuations is to be accounted for by the varying extent to which the various beds rich in fossils have been worked over by palaeontologists. The discovery of a new bed may result in the addition of a number of genera to the lists of those of which fossils have been found. Similarly more intensive excavations in beds that have not been completely explored for various reasons lead to lengthening of these lists. As the result of recent discoveries more than 120 new genera have been added to the lists made by me in 1932. For this I am greatly indebted to the papers of Dr. G. L. Jepson in the 'Proceedings of the American Philosophical Society,' since 1930 and to that of Dr. G. G. Simpson in 'Bulletin 169 of the United States National Museum,' also to the new 1937 edition of Dr. W. B. Scott's *A History of Land Mammals in the Western Hemisphere.*

From the above it is evident that the fossil record of the genera of Tertiary mammals is nearly, if not quite, complete. This fact

is of great importance in connection with the non-discovery of the intermediate fossils demanded by the theory of evolution.

Yours sincerely,

D. DEWAR.

APPENDIX

STATISTICS SHOWING THE EXTENT TO WHICH MAMMALS HAVE LEFT FOSSIL REMAINS IN TERTIARY AND LATER ROCKS

In order to gain some idea of the degree of completeness of the fossil record of mammals since the beginning of the Tertiary Period I have :

1. Ascertained the percentage of the genera now living of which fossils have been found, and

2. Compared the number of genera now living in Europe and North America with the number shown by the fossils to have lived at various stages of the Tertiary.

I. Percentage of living genera of mammals of which fossils have been found.

Here are the results of these enquiries :

Some years ago Levett-Yeats and I devoted much time to the working out of this percentage. The results of our labours are summarised in Tables I and II :

TABLE I

Type of Mammal.	No. of genera now living.	Percentage of such of which fossils have been found.
Land	408	60.54
Marine	41	75.61
Volant (Bats)	215	19.07

The Fossil Record of Marine Mammals

The above figures show that fossils of more than three-fourths of marine mammals (whales, sea-cows, seals, etc.) have been found. As new fossils are frequently discovered, it seems likely that, before fifty years have elapsed, fossils will have been found of every living genus. That this forecast is not unduly optimistic is suggested by the fact that in 1931, when Levett-Yeats and I made our enquiry, fossils had been recorded of 70.73 per cent of living genera, and later discoveries have since raised the above to 75.61.

The Fossil Record of Land Mammals

The above figures show that the percentage of land mammals of which fossils have been found is lower than that of marine animals. The figures

are also less conclusive, because fossils of about 42 per cent of these genera have been found only in deposits near the surface, which, being above sea-level are subject to denudation entailing the destruction of fossils. But, *per contra* (and this applies also to marine mammals), these genera are still living and in consequence fossils of them are now being laid down and this is likely to continue for many years to come; thus their possibilities of fossilisation are far from being exhausted. To overcome the difficulty presented by land mammals No. 2 of the above investigations was undertaken. Before considering this, let me give some statistics indicating that the reason why relatively fewer fossils have been found of land than of marine mammals is our lack of knowledge rather than the incompleteness of the geological record of land mammals.

TABLE II

PERCENTAGE OF GENERA LIVING IN EACH CONTINENT OF WHICH FOSSILS HAVE BEEN FOUND

Continent.	No. of genera of land mammals now inhabiting it.	Percentage of these genera of which fossils have been found.
Europe	48	100.00
North America	71	94.44
South America	86	72.09
Asia	134	72.06
Africa	145	53.79
Australia	48	45.83

As there is no known reason why mammals should be less readily fossilised in some continents than in others, the percentages in the Table are almost certainly indices of the extent to which the various continents have been explored geologically. Future discoveries will probably eventually bring the percentage of each continent up to 100 and thus demonstrate that the geological record of the Tertiary Period is complete in respect of genera of land mammals.

The Fossil Record of Volant Mammals (Bats)

So far fossils of only 19.07 per cent of the living genera of bats seem to have been recorded. This low figure, despite the fact that these animals are less liable than marine or ordinary land mammals to meet with accidents resulting in fossilisation, does not necessarily mean that the geological record is incomplete in their case. One cause of the present low figure is that most kinds of bats are confined to areas in the tropics in which very little geological exploration has been made. Fossils of all five genera of bats now living in England have been found, and this is equally true of every genus now found in Europe. It is within the bounds of possibility that fossils of every genus of bat may eventually be found.

In conclusion we have to consider the past populations of the land mammals of Europe and North America.

2. Comparison of the numbers of genera of land mammals now living in Europe and North America with those shown by the fossils to have existed in those continents at various stages of the Tertiary Epoch.

The fossils are the only means available of knowing whether or not any genus of animal was in existence in any particular period of the past. The fossil records may be said to be the census returns of prehistoric times. If we find the fossils of 100 genera in the rocks of any period, we know that 100 genera were then in existence ; there may have been many more but there cannot have been fewer. Here are some of these census returns.

TABLE III

NUMBER OF GENERA OF NON-VOLANT LAND MAMMALS KNOWN TO HAVE LIVED AT VARIOUS STAGES OF THE TERTIARY AND QUATERNARY IN EUROPE AND NORTH AMERICA

Stage	North America	Europe
NOW LIVING	72	48
Pleistocene	117	68
Upper Pliocene	52	47
Middle Pliocene	28	48
Lower Pliocene	67	88
Upper Miocene	61	82
Middle Miocene	54	59
Lower Miocene	63	52
Upper Oligocene	61	43
Middle Oligocene	66	41
Lower Oligocene	61	80
Upper Eocene	46	68
Middle Eocene	80	38
Lower Eocene	78	24
Upper Palaeocene	60	14
Middle Palaeocene	68	
Lower Palaeocene	32	

DEAR DEWAR,

My first duty is to make it clear that the choice of geology as the subject with which to begin our detailed discussion of evolutionary evidence is not mine. The editor has taken the responsibility for the choice. Consequently my letters must not be regarded as an attempt to present a logical and coherent statement of the case for evolution. It is an order that implicitly assumes that evolution has taken place, and puts in the first place the subject in which I have to meet the most important of your difficulties. As is clearly shown by Lunn's quotation from Huxley, the idea of organic evolution

became widely accepted in the scientific world when the evidence from geology was practically non-existent. Since then, as I shall show in the next chapter, very powerful evolutionary evidence has been found, but this is additional to the general evidence on which the idea was originally based.

There is some confusion of thought on this matter on both sides. I have heard it stated by people of some knowledge and considerable intelligence that the question of evolution was settled because fossils have been found which prove its occurrence. In a sense this is true. The original evolutionists were well aware of the very slight palaeontological evidence, and would gladly have welcomed confirmatory evidence from the fossils. This confirmatory evidence has been found, and so far as it goes it is very good. It is what the early evolutionists wanted and more—*for confirmation*—but it is not sufficient and complete in itself. To put it in another way—in some cases it is very good, but in a large number of cases it is still missing. The reason of course is quite obvious. The geological record is very imperfect. No ordinary sensible person expects it to be otherwise. This general question of the imperfection of the geological record I must defer to my next letter, as in this letter I have to deal with a number of arguments which I suppose are intended to show that the record is not imperfect, or at least not seriously so.

You will thus see how fundamentally I differ from your first paragraph. I had better quote it: 'The theory of evolution must stand or fall by the evidence of the fossils. These furnish the only *direct* evidence. If this be against the theory, no amount of indirect evidence can avail.' Well, well! In the first place, though there are many theories of evolution, I am not prepared to admit that there is any *theory* of evolution. Evolution is something that has occurred, explain it how you will. Nor can I agree that it *must* stand or fall by the evidence of the fossils. There is no must about it. There is no *a priori* necessity that there should be any fossils at all. And whether there are enough to be of any use in our discussion is a matter for detailed investigation. It is theoretically possible that fossil evidence might be so complete as to render further discussion superfluous. It is possible that in the future it may be so, but at present I should hardly venture to say that it is. It is again theoretically possible that the fossils might give evidence against evolution, but as a matter of fact there is no such evidence. Much evidence we should like to have is missing—that is all.

Once again, fossils do not give direct evidence. You might find a fossil of a species of fish which was ancestral to the whole of vertebrate land life, but it would not be labelled, and, if we found it, we should not know that it *was* ancestral. To know which forms are approximately in the line of descent of modern species requires very complicated inferences, and it is wholly impossible in the present state of knowledge to know whether they actually are so. Propliopithecus may be the ancestor of man and the apes, or it may not, we don't know. Piltdown man may be the ancestor of modern man, or it may not, we don't know. To disentangle the evidence given us by the vast complexity of nature is a very long process. Things are not as simple as you appear to think. It would be difficult to put together a plausible sentence more fallacious than the one with which you commence your letter.

As some of your other sentences are just as fallacious, it would take up too much space to try to deal with them. This will have to do as a sample. As a rule I have no use for wild general assertions, and cannot find space to deal with them.

Instead of that we will look at some of your detailed evidence, and particularly your tables. In Table 2 you give the percentages of living land mammals of which fossils have been found. What about it? We must remember that fossil is a relative term. The relics which remain recognisable for 100,000 years may not be sufficiently well preserved to last a million years, to say nothing of 10, 100, or 500 million years. I am not referring to the plain fact that the position of these fossils, usually in caves or river gravels, are never, or very rarely, those in which fossils are found in older formations. I know of no instance of early fossils found in what was originally a cave. And river gravels, when they appear at all, appear as conglomerates (though most conglomerates are old sea beaches) which are very poor in fossils. What is more important is that the fossils very often do not remain in the rocks at all. They get removed by underground water and other natural agents, or destroyed by metamorphosis. Those that remain (in secondary and primary formations) are lucky finds. I will deal with this more fully in my next letter.

Your third and most important table shows that a considerable number of fossils of *land mammals* in *Tertiary* formations have been found. What about it? As the evidence for evolution in Tertiary land mammals is so strong, it naturally follows that a large number *have* been found. Where many fossils have been found the evidence

for evolution is strong. Where few fossils are found, the evidence is weak—naturally. What you seem to be trying to prove is not only that the record is much better than usual, but complete—or nearly so. You give no reasons for this, or at least the only one I can find is the following: 'Future discoveries will probably eventually bring the percentage of each continent up to 100 and thus demonstrate that the geological record of the *Tertiary Period* is complete in respect of land mammals.' It is difficult to comment on this. The percentage in each continent refers to living creatures. The Tertiary Period is about 70 million years. There is no connection between fact and inference, especially as I have already pointed out that few of these fossils would be found if deposited in a similar way in earlier epochs. I may also remark that your tables have very little bearing on the geologic record as a whole. The third and most important refers to land mammals and to the last 70 million years. What is this in comparison with the 1,000 million or more of the earth's history? This comparatively brief time is merely the last period of mountain building. There were quite a number of similar periods before. Of course the last phase is better preserved than the others.

One obvious reply to your implied contention that the record is reasonably complete is that new discoveries are continually being made. You cannot make new discoveries if there is nothing to discover. The tables themselves show obvious incompleteness: 52 genera in the upper Pliocene compared with 117 in the Pleistocene in America, and in Europe 80 in the lower Oligocene and 41 in the middle Oligocene. Another point to notice is that the Pleistocene is a short period of only about a million years, in which few if any new genera would have time to evolve, whereas the average third part of the previous epochs is about 6 million years in length, giving ample time for more than one series of genera in a rapidly evolving class. Moreover, if you find all the genera, you still have not all the evidence for evolution we should like to have, or even all that has in a few special cases been found. Finally it is quite easy from an incomplete fossil, sometimes only a lower jaw, to infer that it represents a genus not previously known, but it would be very difficult indeed to interpret its evolutionary significance. To do this properly requires a fossil that is reasonably complete.

I know you attach considerable importance to these tables, and so have given them more attention than I should otherwise have done; but I think you would do well to explain quite clearly and

explicitly what you think they prove. Personally I regard them as a side-issue and must defer the main question of the value of the geologic record to my next letter.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

It is easy to see why you dislike the editor's decision about the order of our discussion, because it reveals very early in our debate the weakness of the evidence for evolution, but logically the decision is correct. It is the order adopted by Chambers, who forestalled Darwin, in his *Natural History of Creation* published some 15 years before Darwin's *The Origin of Species*. Chambers devotes the greater part of the first 100 pages of his book to what he calls 'the wondrous section of the earth's history which is told by geology.' Then he proceeds to interpret the successions of the fossils on the theory that the later ones evolved from the earlier. After that he adduces subsidiary facts relating to morphology, embryology and geographical distribution in support of the main evidence—that of the fossils. But his book, although it went through eleven editions, did not exercise much influence, because the only direct evidence is so unfavourable. Darwin was astute enough to see this and in consequence took care to put the geological evidence in the background. He devoted the first half of his book to the variability of animals and to trying to make his readers believe that, given time enough, the variations exhibited by animals afford natural selection unlimited material upon which to operate. Then he comes to the testimony of the fossils, and asserts that this counts for little as the geological record is exceedingly incomplete. Thus he succeeded in fooling a world only too willing to be fooled. You, in our debate, very naturally want to follow the procedure which Darwin found so successful.

You say you disagree fundamentally with my assertion that the theory of evolution must stand or fall by the evidence of the fossils as this is the only *direct* evidence. You say there is no *a priori* necessity that there should be any fossils at all. This is true, but the only hope of proving evolution is the appeal to the fossil record. Apart from this no one can know (apart from revelation) whether or not animals or plants or men existed on the earth 10,000 years ago. Were there no fossils all theories of evolution would be merely

interesting speculations which could neither be proved nor disproved. Clearly then, if the theory of evolution is to have a scientific basis, that basis must be the fossil record. This is why the statistics contained in the tables I have compiled are of great importance.

What the Statistics in Tables I, II and III prove.

You ask me to state explicitly what the statistics in the appendix to my last letter prove. The answer is that they go a long way to confirm in the case of mammals (they relate only to mammals) the conclusion, based on animal population figures, that every genus having hard parts leaves a fossil record in the rocks. Table I shows that fossils have been found of more than half the living genera of land mammals, three-fourths of those of marine mammals, and about one-fifth in the case of bats. In order to show the extent to which mammals are fossilised an unknown number, x y or z, must be added to each figure in the table to represent fossils now in the rocks that have not yet been found of genera not included in the above figures, and to allow for the fact that, as the genera are still living and fossils of them are now being laid down, the record of these genera is still being compiled. In this connection I must comment on your naïve statement: 'One obvious reply to your implied contention that the record is reasonably complete is that new discoveries are continually being made. You can't make discoveries if there is nothing to discover.' Cannot you see that you can only discover something that exists? You can only discover fossils that have been laid down. Every discovery of a fossil of a genus of which no fossil has already been recorded proves that the fossil record is more complete than it was known to be before the discovery.

Table II was compiled with the object of ascertaining as far as possible whether the reason why fossils of every genus have not been found is the incompleteness of the record, or inadequate exploration by the fossil hunter; and the data make it almost certain that in most cases the latter is the reason. Thus the table gives evidence in favour of the completeness of the record. The statistics embodied in Table III were obtained with considerable labour with the object of trying to discover the extent to which fossils are destroyed in the manner suggested by you and in any other manner. If this destruction be considerable, then the older the period the fewer should be the genera which the rocks of the period in question contain: the numbers should fall off as we read

down the table. They do not. They show irregularity, for reasons I have explained.

As the oldest known undisputed fossil was laid down about 500 million years ago according to the time-table we have agreed to accept for the sake of argument, the 70 million years of the Tertiary should be compared with the 500 million years of the fossil record, not 1,000 million, and so the Tertiary period represents about one-seventh of the period between now and the beginning of the Cambrian. Thus the question arises: since there seems to have been little destruction of the fossil record in 70 million years, is the destruction likely to have been very great in a period four times as long?

If you do not accept my contention I presume you will adduce statistics supporting your assertion that the geological record is very imperfect. I will now adduce evidence in support of my assertion that:

The Geological Record is not far from complete in respect of marine animals having hard parts.

I may here say that, apart from the late Mr. G. A. Levett-Yeats, who gave me great assistance, I believe that I am the only person who has made the least attempt to ascertain the degree of completeness or otherwise of the geological record. As the labour involved is considerable and I have not been able to devote very much time to the enquiry, I have had to confine it in the case of marine animals other than mammals to the molluscs that live and have lived in the British Isles area. Even this limited enquiry is not nearly complete, but it has gone sufficiently far to reveal a number of facts very unfavourable to all theories of evolution. The statistics I have compiled are set forth in the appendix to this letter.

Table IV shows that, in all, fossils of 74.58 per cent of the living genera of British molluscs have been found. It also shows that the percentage varies greatly with the group. The variation is due to the fact that in some groups all the genera have shells, while some members of the others lack shells, and in the case of the cephalopods (cuttle fishes) the only 'hard part' is the cuttle-bone, which is soft and easily decomposable. In the case of these last, fossils have been found of only 3 of the 11 living genera. In the opisthobranchiata (the class that includes the sea-slugs), 41 of the 57 genera lack shells or any kind of hard part. Fossils of these are almost unknown. One of the Pulmonata (snails, etc.) lacks a shell

and no fossil of this has been found. Table V shows that of the 187 genera of British molluscs having shells, fossils of 176 have been found, leaving 11 genera of which I have found no fossil record. Of these, one has no shell in the adult state, five have minute shells $\frac{1}{10}$ inch long in two cases and less than $\frac{1}{4}$ inch in the others; the shell of two of the others is as thin as paper, and one is an ecto-parasite.

Table VI shows the number of British genera which the recorded fossils *prove* to have been in existence in each of the geological periods. In order to demonstrate the significance of the figures in the table, let us consider those for the Eocene period. They show that 138 of the 187 genera now living in the British area were living in that area in the Eocene period. These 138 do not represent *all* the genera of which fossils have been found in British Eocene rocks, but only those that are still living in England. To these must be added the genera that were living in England in Eocene times but have since become extinct or have migrated to warmer climes. I have come upon records of 62 of these, and my enquiry is not yet completed. Thus we must add 62 to 138 and we find that at least 200 genera of molluscs lived in the British area in the Eocene period—*a greater number than are now living in it.*

You concede that you cannot produce a lineage series of fossils linking one Order with another, still less one Class with another Class. You appeal to the imperfection of the geological record which has resulted in the disappearance of the fossils you need to support your theory, fossils of millions of genera that must have existed if slow and gradual evolution be true. All the genera linking Order and Order, Class and Class, Phylum and Phylum have vanished. You can at best point to a few dubious forms which you label transitional.

Your theory stands or falls with the doctrine of the great imperfection of the geological record. But how can you sustain this doctrine in face of the statistics embodied in the above tables? How can you square it with the very high proportion of living genera found in fossil form? Why should all the fossils necessary to prove your theory have vanished and those necessary to demonstrate the comparative perfection of the geological record have survived?

Yours sincerely,

D. DEWAR.

APPENDIX

TABLE IV

British Molluscs

Class of Mollusc.	No. of genera now living.	No. of genera now living of which fossils have been found.	Percentage of living genera of which fossils have been found.
I. Lamellibranchiata (bivalves)	67	67	100.00
II. Gastropoda			
Polyplacophora	1	1	100.00
Prosobranchiata	77	76	98.70
Opisthobranchiata	57	11	19.30
Pulmonata	25	19	76.00
Scaphopoda	2	2	100.00
III. Cephalopoda	11	3	27.30
Total	240	179	74.58

TABLE V

British Molluscs having External Shells

Number of genera now living.	No. of these of which fossils have been found.	Percentage.
187	176	94.20

TABLE VI

Fossils of British Molluscs

Period.	Number of genera of which fossils have been found.
Pliocene	173
Eocene	138
Cretaceous	95
Jurassic	64
Triassic	41
Permian	33
Carboniferous	31
Devonian	19
Silurian	16
Ordovician	6
Cambrian	1

Dear Dewar,

The statement that I dislike the editor's order is hardly correct. It all depends what you want from me. If you merely want an

answer to your difficulties, one order will do as well as another. If, however, you want me to state the case for evolution in a clear and logical manner, I cannot do that unless I am allowed to choose my own order. This requires to be stated quite definitely from the start. With regard to geology, the position at present is that, as I shall show in the next chapter, there is ample evidence for evolution, but much evidence we should like to have is missing.

It is not necessary to give further attention to your tables. In my last letter I showed that your first three tables indicated quite clearly that, even for land mammals in tertiary formations, the record is seriously incomplete. Your sixth table shows the same thing for the molluscs. There is no need for me to make out new statistics. Yours suit my purpose well enough.

I think, however, that you do not realise the great difference between the record of the present period of mountain building and those of previous epochs. When there is a continuous period of mountain building, which is what has happened since the Eocene, the deposits which have been formed in seas and lakes are pushed upwards, and are available, in so far as they are accessible, and have not already been eroded away. But when they have been eroded away, *they are gone*. This is what has happened to the earlier deposits, to which this process has been applied several times. Consequently, what remain are fragments, and it would be absurd to expect that they would be continuous in time. We get, as would naturally be expected, abundance of fossils now and again, but with gaps. What surprises me is not that the record is fragmentary, but that it is as good as it is. Certainly in the earlier epochs it would be very surprising if we found anything approaching continuous series.

It is instructive to be asked to give reasons for this natural assumption of the fragmentary nature of the fossil record, especially that of earlier epochs, because it is one of those things which we are liable to take for granted. All the same, I think some very cogent reasons can be given. In the first place, I must point out that the argument that because evolutionary evidence is missing therefore the record is fragmentary is not the *petitio principii* that it might appear to be at first sight. If there were no geologic evolutionary evidence it would be arguing in a circle; but when there is very good evolutionary evidence in a few special cases, and obvious links are found in other cases when series are missing, the inference that the record is incomplete is not altogether fallacious.

Otherwise we should be faced with the extraordinary conclusion that some forms of life (as for example a large number of land mammals) have been evolved and other forms have not. To say the least, this would be peculiar. We all of us expect to find some sort of order in nature, and if we fail to find it we naturally assume that we have not sufficient evidence.

We are not, however, dependent on arguments like these. Our knowledge of the rocks gives us all the evidence we need. I think we can assume that most of the recent sedimentary rocks contain fossils of some sort. *But they do not stay there.* I do not merely mean that the rocks are destroyed by erosion, I mean that even when the rocks remain the fossils often disappear. An obvious example of this is metamorphosis, which destroys them altogether. What is still more important is the solvent action of underground water, and similar agents. It is not all sedimentaries, even those which show no obvious sign of metamorphosis, which contain fossils. Any good text-book on geology will tell you this. The usual statement, which you will find in Geikie, is that as a rule shales are fossiliferous and sandstones are not, though there are exceptions on both sides. I think we can assume with confidence that as a rule the fossiliferous sandstones are comparatively recent, and the unfossiliferous shales more ancient formations, though here again there is no absolute rule. Thus, as we go back in time, not only are there serious gaps in the sedimentary series, but many of the rocks that remain have lost their fossils. Consequently the fossils that remain, while they merely form an incomplete record in recent formations, become more and more fragmentary as we go back to earlier times. What then remains is a number of lucky finds which we have to try to piece together as best we can. Our general conclusion must be that, while the fossils that have been found are evidence, we must be exceedingly careful what inferences we make from the absence of fossils.

There is a point of definition here which needs emphasis. We need to be quite clear what we mean by the fossil record. I know of only one meaning which has relevance to the present discussion. By the fossil record I mean *the fossils that have actually been found.* Consequently, any remarks you make on the fossils that have been laid down (whatever that may mean) or those that are in existence, or even those that are available, have very little bearing on the matter. There is, for example, in your letter on p. 59 a passage in italics about a nearly complete record in rocks laid down in the sea,

which the subsequent paragraph explains as meaning so long as they stay there. I am not disposed to argue what fossils are now under the sea, as they are not available, and so not part of the fossil record. The point is that it is only by a lucky chance that a palaeozoic deposit has stayed there all this time, and now has come up conveniently for us to examine it. These lucky chances do occur, and that is why we know anything about palaeozoic fossils, but you should realise that it is an outside chance, and can only be expected to give us fragmentary information about the life of these earlier times.

Nor are we confined to these general reasons. We get cogent evidence of the fragmentary and incomplete nature of the fossil record from the fossils themselves. The following examples will illustrate my meaning :

1. The following passage occurs in your first letter in this chapter : 'Thus, taking the geological record as a whole, it is not far from complete in the marine animals having hard parts.'

I think we may take it that marine animals having hard parts include fish. Now let us look at an interesting example. On the 18th of March, 1939, an announcement was made in *Nature* of the discovery of a living fish which was supposed to have been extinct since Mesozoic times. The discoverer states that it is nearly related to the Macraphorna of Agassiz, and is more nearly related to the earlier types (Jurassic) than to the later ones. Thus, in the 150 million years or so since the Jurassic, during the formation of the most recent and complete part of the fossil record, these fish have been in existence and *not a single fossil has been found.*

2. The second relates to birds. Two specimens of the feathered reptile Archaeopteryx and one or two of the related Archaeornis have been found in the Jurassic. There is then a gap of fifty million years or so, and in the upper Cretaceous we find birds with teeth. Then there is a smaller gap and birds nearer to the modern type are found in the Eocene. Where are all these missing feathered creatures? Surely there were feathered creatures in all this time, but their fossils have not been found. A further fact about birds is Zittel's statement that 12,000 living species are known, but only 500 fossil species have been found. These figures speak for themselves.

3. The third relates to amphibia. Until recently no anura (frogs and toads) were found earlier than the Eocene. Recently specimens have been found in the Jurassic, but none in the Cretaceous.

4. The fourth relates to land mammals. Since the Eocene the record is good. But specimens which from their bony structure appear to be mammals are found in the Jurassic, and possibly even in the Triassic, but the very few specimens that have been found, some of them only lower jaws, show how fragmentary the record is. The collection in the Natural History Museum, which is said to be the second largest in the world, is very scanty indeed.

5. The fifth example is a general one, showing how difficult it is to trace a phylum to its source. Fragments of vertebrate bone have been found in the middle Ordovician, but no recognisable vertebrate skeleton till the late Silurian—a gap of 50 million years or so.

We need not multiply instances. Quite a number of cases can be found when orders or classes are found in two epochs not consecutive, but not in the intermediate epoch.

The common sense attitude is very simple. It can briefly be stated in the obvious question : where do the fossiliferous rocks come from ? Your statement that upheaval and erosion is purely a local affair is very misleading. If you mean that the oceanic mass as a whole is relatively permanent, most geologists will agree with you. But when we remember that the Himalayas now tower beyond the reach of the human climber where it once was sea, we can appreciate that upheaval is more than local. The American Geological Survey have calculated that about three quarters of the rocks subject to erosion are sedimentary, the rest being igneous or metamorphic. We must also remember that metamorphic, and to a lesser extent igneous rocks, imply a considerable destruction of earlier sedimentary rocks. This answers the question. All the later sedimentary rocks exist because an equal volume (or approximately so) of earlier sedimentary rocks have been destroyed, ground to powder, carried to the sea and re-deposited. The same applies to earlier formations. Consequently it follows that the earlier rocks that remain are only a minute proportion of what has been laid down, and this proportion becomes less and less as we go back in time. It would be most extraordinary if these deposits were continuous, or anything like it. We have a succession of fragments, a very small proportion of which have been thoroughly explored. The conclusion seems so obvious as to need no further explanation.

In dealing with your exposition I have to guard against the danger of overstating on the other side. There is one aspect that gives hope for the future. Very few even of the rocks that are now

available have been thoroughly explored. Up to the present we have been mainly confined to the outcrops, and even of these it is only parts of Europe and North America which have had a reasonably good preliminary exploration. No doubt rocks bridging present gaps will be found in future, and very slowly a much better record than now exists will be built up. Yet I greatly doubt whether it is possible in more than a few isolated instances to find such series for earlier evolution as are even now available for the ancestors of some of our existing land mammals.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

You say that what you mean by the fossil record is the fossils *that have actually been found* . . . and as fossils under the sea are not available they are not part of the fossil record! Clearly you have failed to distinguish between the fossil record and our knowledge of it. This explains the remark in your first letter which mystified me, that the record cannot be reasonably complete because new fossils are constantly being discovered. By the term fossil, or geological record, I mean the testimony of the rocks which consists of the fossils they now hold *plus* those dug up by man. Its completeness has nothing to do with the extent to which it has been explored by man. A fossil in the bed of an ocean or under ice in Greenland is as much a part of the record as one that will be dug up next week in England.

Please bear in mind that most of the marine rocks known to us contain much terrigenous material, and, in consequence, seem to have been formed within two or three hundred miles of the shore. Thus the fossils these rocks hold are of *organisms which lived near the land.* Further, there is evidence that most rocks devoid of terrigenous matter, e.g., chalk and some limestones, were laid down near land. Thus *the known marine fossils represent, not all oceanic plants and animals, but merely those living near the coasts.*

Here are comments on your examples of the imperfection of the fossil record:

1. The fact just mentioned disposes of the difficulty of the recent discovery of a living Coelacanth fish supposed to have become extinct 150 million years ago. Something caused this fish to move from the coastal to the open seas, so that any fossils of it that may

have been formed since are buried under the sea. That only one specimen has been caught within living memory suggests that it is not a common denizen of coastal waters. The fact that it is shown by the fossils to have been in existence 150 million years ago affords an example of the stability of species or genera.

2. I am greatly amused at your calling Archaeopteryx a feathered reptile. It is as good a bird as the duck-billed platypus is a good mammal, so why not call platypus a hairy reptile? The paucity of fossils of birds in Mesozoic or Secondary rocks is easily explained, because, as I stated in my first letter in this chapter, flying animals are less liable to fossilisation than ground animals. Moreover, birds, other than those that subsist on fish, are almost entirely directly or indirectly dependent on flowering plants, which in the Jurassic and the first half of the Cretaceous period had not reached the lowlands, at any rate outside the Arctic Circle. Before this they were confined to the uplands, where the rocks laid down in the Secondary period have been almost entirely eroded away with the fossils they contained, as I said in a former letter (p. 60).

3. This last fact accounts for the paucity and very fragmentary nature of the known fossils of Mesozoic mammals. These were confined to the uplands, and their fossils laid down there have disappeared. What remain and have been found are parts of their skeletons carried by streams to the lowlands where they were buried and became fossilised.

4. Fossils of frogs and other modern amphibia are very scarce; I doubt whether, all told, those of forty genera have been found. This may be due to their soft, slender bones being easily decomposed after burial. If the fossil record were as incomplete for other vertebrates you would have quite a good case for pleading the poverty of the record as a reason for the non-discovery of the thousands of links required to support the evolution theory.

5. The facts you mention, while not quite accurate, show, in my view, that fishes existed in the Ordovician and most of the Silurian period (also in the Cambrian), but they were then very scarce in the coastal seas. As I shall show, since the Ordovician there have been several waves of fishes invading the coastal seas.

I do not know what you mean by 'epoch,' but I am surprised at your statement that quite a number of Orders and Classes are found in two epochs, but not in the intermediate one. Please name six cases of each, merely giving the name of the Class and Order and the epoch in which their fossils are missing.

In conclusion, let me say that your examples of the imperfection of the fossil record are all of animals that are not very readily fossilised or that inhabited localities of which the fossils are not accessible or have been eroded out of existence. You have not tackled my statistics relating to molluscs which are readily fossilised. These show that in some groups fossils of 100 per cent of living genera have been found, and that the number of molluscs living in the British area was greater in the Eocene period than it is to-day. Here are some further facts. The fossil record tells us that more than 220 new families of molluscs have appeared between the Cambrian and the Eocene periods. According to you, each of these evolved from some pre-existing family. Six genera intermediate between each of these and its parent family is a low estimate (ten would be nearer the mark). This means that more than 1,200 intermediate genera of molluscs must have existed in the past, of which no fossil seems to have been found. If this large number of intermediate genera really existed, is it credible that none of their fossils should occur among the 1,000 odd genera of which fossils have been found?

The fossil statistics of the other phylum of animals having shells —the Brachiopods or Lamp-shells—are even more unfavourable to your idea of the imperfection of the fossil record. This record tells us that no new Class of Brachiopods has evolved since the Cambrian period, i.e., during the last 500 million years. The record also tells us that a greater number of Brachiopods existed in the Middle Cambrian period than are now living: 37 as opposed to 33.

Here we have yet another example of the fact that this record—so imperfect according to you—reveals a greater number of genera of Brachiopods living in the Cambrian period than in the world around us. If the record be as fragmentary as you make out, then would it not seem that the 37 Cambrian genera revealed by it indicate that, shall we say, 37,000 genera of lamp-shells lived in the Mid-Cambrian period?

Genera may be divided into two kinds: those which we know to have existed, and those whose existence in the past is essential to the theory which you affirm and I deny. How can you account for the *amazing contrast between the richness of the record in respect of the genera which are known to exist and the appalling poverty of the record in respect of the genera necessary for your theory?*

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

This discussion seems to me to be petering out, and I have little more to say, having I think proved my point. The only reason for the few remarks that follow is to point out for the benefit of the general reader that most of what you say in your last letter is irrelevant to the issue we are discussing.

The object of this chapter, arranged by the editor, so far as I am able to understand it, is to argue whether the admitted gaps in the evolutionary series are due to evolution not having occurred or to deficiencies in the fossil record. *Obviously*, if this is the point under discussion, the only meaning of fossil record that has any bearing on the matter is *the fossils that have been found.* The other point—the fossils that exist but have not been found—has no bearing on the discussion. Of course, when I point out that fossils have been destroyed by erosion, by metamorphosis, by the action of underground water, and in other ways, that is relevant, because if they are destroyed they *cannot* be found. But when you speculate about what are in existence under the sea, or in other inaccessible places, or indeed in accessible places, I am not concerned to argue the matter. Speculate away if you like, but it is not incumbent on me to notice anything you have to say. I am only concerned with the fossil record in the sense of our knowledge of it. The rest is pure speculation and irrelevant.

I note your explanations of *why* our fossil record is fragmentary in certain cases. Again that is speculative, and I am not interested. The important point is that it *is* fragmentary, and, that being so, the evolutionary evidence is what it would be expected to be, that is reasonably good in a few special cases, but generally speaking, showing only a few obvious evolutionary links.

You will now, I think, understand the meaning of one of my arguments which puzzled you. You gave tables intended to show that a fossil record of land mammals *had been discovered* (at least I hope you meant that or your tables are valueless) which you thought to be reasonably complete. I pointed out that as new forms are continually being discovered it could not be complete. This, of course, is additional to the uncertainty whether many of the forms that existed are there to be discovered. The confusion is entirely yours. I always use the term fossil record in the sense of *our* record, the fossils that have been found. You vary in your use of the term, and so cause confusion. Is it allowable to suggest that it is partly because you are liable to similar confusions that you are an anti-evolutionist?

There is one other point in your letter which requires notice. You want to know why a large number of genera of Brachiopods are found in the Cambrian. I don't know. Nor do I know how many have not been found. In our fragmentary fossil record we have from time to time lucky finds. Now and again rich fossil beds are found. When you make such a lucky find, obviously you find a great variety of fossils. Why not? And what has it got to do with the question under discussion? You do occasionally get a rich find of certain types of creature which happen to be abundant at the time, and which are liable to be fossilised under the particular conditions existing when that particular rock was being formed. This gives us no information about their ancestors or descendants. Nor does it even tell us the period of time between the formation of this rock and the formation of the next one containing fossils which were formed under similar conditions, that is, of course, assuming that such a thing exists, which is by no means obvious.

Now let me summarise what I have said in this chapter. The fossil record (our record) at its best is very incomplete. In a few special cases, such as Tertiary land mammals, it is good enough to give us detailed evidence for evolution. Generally speaking, especially in earlier epochs, it is fragmentary. Then we only get occasional links. These links, though not detailed evidence, are evidence. In short, the evolutionary palaeontological evidence is very much that which from the very nature of the fossil record, it would naturally be expected to be.

Yours sincerely,

H. S. SHELTON.

P.S.—I will discuss Archaeopteryx in the next chapter.

3

THE GEOLOGICAL RECORD (ITS CONTENT)

DEAR DEWAR,

In the last chapter we discussed the value of the geological record. Although we disagree about the extent of its incompleteness, we agree that it is better in the Tertiary formations than in earlier epochs. You also in your tables showed that a considerable number of genera of land mammals have actually been found in these later deposits. Moreover it happens that in the tertiary formations the evolutionary record of the land mammals is better than that of other classes. We are fortunate in that a very considerable amount of evolutionary change has in fact taken place in land mammals during that period, whereas, in the reptiles, birds and amphibia the most fundamental changes took place earlier. The reason for these introductory remarks is to make it clear that there is no contradiction between my contention that the geologic record as a whole is very imperfect, and, what I propose to show in this chapter, that the record, such as it is, gives very powerful evolutionary evidence.

This letter, therefore, will deal only with land mammals, and I shall still further limit it by confining it to one branch. Naturally I am choosing the best example. There are others, but they are not quite so good, and I shall mention them briefly later. The branch I have chosen is the fossil equidae, that is the ancestors of the present horse genus, which now consists of varieties of the horse, the ass and the zebra, together with the recently extinct quagga. We need to emphasise from the start that the fossils of this group, after the first step or two, are related to all living equidae in exactly the same way as they are to the horse, and no distinction can be made between them.

According to Lydekker, the late Pliocene Equus stenonis was a variable species, different specimens of which showed similarities to the ass and the zebra as well as to the modern horse.[1] In other words these different species seem to have disappeared, and a single generalised species to have taken their place. Equus caballus, the modern horse, has gone. (H.249.)

[1] *The Horse and its Relatives*, p. 248 (referred to later as H.).

Behind this late Pliocene form is a valuable series. I have referred to a number of books and find them all in substantial agreement on the order and details, so will now follow that of the *Science of Life*[1] (in future referred to as S), though I am putting the facts in the reverse order to that given there. Very little earlier than Equus stenonis, and possibly contemporary with it, is a form known as Plesippus (S.349). In this form the teeth are not so well developed as in the modern species, the splint bones are longer and expanded at the tip, and there is a nodule of bone representing the fifth digit.

Previous to Plesippus, and found in deposits ranging from the late Miocene to the middle Pliocene, is a genus known as Pliohippus. In this genus the transition from the three-toed to the one-toed animal is completed. Some of the species have small side toes with hoofs, and in others the hoofs are missing, and the remnants are splints larger than in existing species. The teeth are similar to Plesippus. (S.348.)

Previous to Pliohippus, earlier in the Miocene, there seem to be two genera: Parahippus and Merychippus, both very near the direct line of descent, and to some extent overlapping in time, though Parahippus is found earlier. Merychippus always has three toes two of which never touch the ground. In the young of the species a frail separate ulna has been noted, though in the adult it is fused with the radius as in the modern genus. Important differences are found in the teeth, those of the later species being considerably longer in proportion to the width than those of the earlier species. In Parahippus the complete ring of bone round the orbit of the eye has disappeared. (H.254.) Another feature of Parahippus is that in the earlier species the cement of the teeth is very thin, and in the next earlier genus Miohippus it disappears altogether. (S.347, 348.)

Miohippus, and the next earlier genus Mesohippus, are found in the Oligocene and in the early Miocene. They are called two genera for convenience, but they seem to grade into one another. In Mesohippus the three toes all appear to touch the ground, the radius and ulna are distinct bones, though the radius is much better developed.

[1] This reference is deliberate. I have noticed in anti-evolutionary circles a tendency to depreciate this book. Where I have been able to check them, I have found its statements of fact reliable, and therefore propose to refer to it *for facts* in exactly the same way as I shall to the other numerous sources of information that are available.

Before Mesohippus, in the later Eocene, comes the genus Epihippus, and here there seems to be a small gap. But Epihippus grades without a serious break into Orohippus of the middle Eocene. In Orohippus the difference between molars and premolars is noticeable. Both genera are four-toed, but the fourth toe is smaller in Epihippus. In Orohippus the radius and ulna approach the normal mammalian type.

The last of the series is Eohippus, earlier in the Eocene, and in this form the adaptations which characterise the modern genus are not to be found. In the fore foot all five digits are present ; four of them are functional, but the fifth is reduced to a splint. In the hind foot there are three functional toes, the fifth is reduced to a splint, and only the first is missing. The teeth are hardly distinguishable from those of the normal mammalian type, and the premolars are quite distinct from the molars. In the nearly related European Hyracotherium the teeth are still more primitive. Radius and ulna and tibia and fibula are normal, and the animal is adapted, not for speed on grassy plains, but for soft ground and for the eating of succulent herbage.

Anything of the nature of a complete series now breaks down in a tantalising way. Although the animal is now very like the ordinary lower Eocene land mammal, there is some doubt about the exact evolutionary steps joining these early forms. I shall say a word or two about that in my next letter. We can disregard a number of interesting related forms which occur at different points in the series, particularly hippidium and hipparion, as they are universally regarded as side branches. It is as well to add that the earlier members of the series are small. Eohippus varies between the size of a cat and that of a terrier, but this is not of great importance, as the cat and the tiger are classified in the same genus.

I think this evidence speaks for itself. What better evidence can any reasonable man expect? There are one or two small gaps, but not large enough to be of consequence. Probably they will be reduced later, and it is even possible that they have already been reduced, but the papers have not come my way. But, taking the record as it is, can there by any reasonable doubt of the genetic relationship of the whole series and of its side branches? I had better make it clear what I mean by genetic *relationship*. I mean exactly what I say, and do not dogmatise about the exact line of descent, that is which form is ancestral to which. As an example,

I could not possibly guess which of the 13 known species of Eohippus gave rise to Orohippus. For all I know the actual ancestor may not have been discovered, and there is similar uncertainty all down the line. No one claims, so far as actual ancestry is concerned, that the series is more than approximate. This question in its proper setting has its interest, but here it seems to me to be irrelevant. If you assert that the exact line has not been made out I agree; but it is only in very exceptional cases that it is possible to make out anything of the kind, and so far as evidence for evolution is concerned it is not needed.

This somewhat tedious exposition, and the further tedious exposition that follows, is necessary because of your previous letters. I have to deal with the objections raised by you, and so must devote considerable space to what I consider to be minor points. I have now in mind the following passage:

'. . . your last letter ignores my challenge to you to cite a series of fossils linking by small steps an order with another order, *or a family with another family*.' I explained at the time that I did not think this attitude reasonable, and that families and orders were not things existing in nature but merely artificial conveniences for classification. I therefore replied: 'the change from Equus to Eohippus can be traced by small steps, and the change is *considerably greater than* that usually implied by linking a family with another family.'

I do not think there can be any doubt about the small steps. I have now to discuss the degree of the change, a discussion which is to me very trivial, but which is necessary because you and Lunn attach so much importance to it. In some cases, such as the Equidae, the family is isolated, and no nearly allied family is in existence. In this series several side branches, including hipparion and hippidium are extinct, and the nearest living relatives are the tapir family, which is more nearly allied to the rhinoceros. The tapir branched off before the time of Eohippus, and consequently it would naturally be expected to differ from the horse more than does Eohippus. But there has been some degree of parallel evolution, and so it is a doubtful point. You can work out this for yourself if you are interested. But it does illustrate the point that you may occasionally find the nearest extant allied families differ as much as Equus and Eohippus. This is exceptional, and for a sound comparison we must find families that are reasonably nearly allied. Generally speaking the differences between a family and an allied

family is *very much less than* the difference between Equus and Eohippus.

Instead of choosing one for myself, I will take Lunn's example of the carnivora, the principal sub-order of which consists of the following recognised living families: cats, civets, hyenas, dogs, bears, and 'procyonidae' e.g. the racoon. I invite you to take any two of these families which are nearly related, e.g., the cats and the civets, or any *nearly related* families in any branch of land mammals, and compare their differences with the differences I shall now list between Equus and Eohippus. The only differences that can be considered are *skeletal differences* as, of course, in the fossil Eohippus we have not sufficient information about the soft parts. The principal differences between Equus and Eohippus are as follows:

(1) The skull is different, in particular the ring round the orbit of the eye is missing in Eohippus, and the muzzle, though still long, is of smaller proportional length.

(2) The teeth are entirely different. The abnormal length has entirely gone, so has the cement, so have all the special features of the horse teeth. The molars and premolars are quite distinct. The first premolar which is rudimentary in the horse is present in Eohippus. The canines, which form the 'tusks' of the horse and are rudimentary in the mare, are present and normal. In view of the importance of the teeth in classification, this in itself is more than a family difference.

(3) The horse has one functional toe and two small splints. Eohippus has four functional toes on one foot and three on the other, in each case with another toe represented by a splint, the hoofs of the horse are exceedingly well developed, whereas those of Eohippus are rudimentary.

(4) In the horse the radius and ulna are fused, and in the hind limb the functional bone is the tibia, the fibula being only a remnant. In Eohippus radius and ulna and tibia and fibula are normal. The proportionate lengths of cannon bone or metacarpal to (say) the humerus (and similarly in the hind limb) are entirely different. The limb of Eohippus could be twisted like that of an ordinary mammal, in the horse the limb works in a single plane to give strength and speed. These differences alone are more than a family difference.

(5) The back of the horse is hollow (another adaptation to speed), the back of Eohippus is arched like those of modern carnivora. (H.274.)

(6) There are a number of minor differences such as size and proportion of length of legs to body which it would be too tedious to mention.

The real question is not what are the differences, but what are the similarities. Both have a skull, a backbone, four legs and a tail. The rudimentary hoofs and vegetable feeding would I suppose classify Eohippus as an ungulate, but really there does not seem to be much more. *The whole structure of the animal is entirely different.* If you think their similarities are such as to justify their being classed in the same family it is for you to say what they are.

I would therefore ask you to make out a similar list of *skeletal* differences between the cats and the civets, or, if you do not like the example, between any two families of land mammals in the same sub-order which are regarded by comparative anatomists as being nearly allied. *Unless you can do so, my point is proved.* Personally, I think it doubtful whether you could make out a list of the same magnitude and importance for the most widely separated families of carnivora which I have mentioned.

There is nothing new, eccentric, or original, about this statement. I think all competent comparative anatomists would agree with me. Classification is for convenience only, and the 'natural family' is a contradiction in terms. When we have a continuous series it is not considered convenient to break them up into families, as the place where we make the division is purely arbitrary. It is only when people take classification to mean something different from what it does mean that a question of this kind arises.

This question of classification is, however, discussed briefly by Lydekker (H.262 seq.). Professor Osborn did not think it convenient to divide into families, and, somewhat casually I think, suggested four sub-families. Lydekker was more of a systematist, and was not satisfied with this arrangement, so he divided the series into three families, and it is by no means clear why he did not make it four. (H.263.)

I would call your attention to the difference between families in an order varying in different ways about a mean and families in a linear series. The differences in the latter case, *especially in the end members of the group* are very much greater.

I deprecate your method of conducting such a discussion as this, which should be carried out in the spirit of calm scientific thought, by 'challenges' and similar means. It happens, however, that this series is better than would naturally be expected, even for Tertiary

land mammals, and so I can meet your 'challenge.' Indeed, I have given you twice as much as you ask. On the basis of Lydekker's classification, which so far as I know is *the only one which takes account of the degree of the difference*, the family Equinae can be traced back by small steps to the family Anchitheriinae in the Oligocene, and this again by small steps to the family Hyracotheriinae in the early Eocene. Your question is answered and your 'challenge' is met.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

Parturiunt Montes, Nascetur Ridiculus Eohippus.

You meet my contention that no series of fossils has been found linking one family with another family by citing facts suggesting that the one-toed horse may be derived from a multi-toed horse, that is, since the family Equidae originated, it has undergone considerable diversification (call it evolution if you like), but this diversification or evolution is *within* the family. Now quite a number of zoologists who reject the evolution theory admit the possibility that all the members of any given family are derived from a common ancestor, indeed at least one, Vialleton, thinks that this probably happened, although it is as yet far from proved. Personally, I am inclined to doubt this, but am quite prepared to be convinced by evidence on the matter. One of my difficulties in believing that Equus is descended from any of the known Eocene horses is the difference in the teeth, which you have rightly emphasised. You have not described this difference. I cannot see how a low-crowned tooth of which the dentine was covered by a coat of enamel can have been *gradually* converted into a rootless high-crowned tooth of which the enamel became enfolded longitudinally in the dentine and the space between the folds filled with a new substance called cement. If you can explain how this happened I shall be grateful. Thus, even if you had proved that Equus is descended from Eohippus or other similar horse, this really has no bearing on our debate on evolution which postulates not only changes within the family but change of one family into another, one order into another, etc., for which I cannot find an iota of evidence. But I am interested because, as I have already said, I have for years been trying to discover the extent to which animals

can become modified in course of time. You evidently appreciate that the proof of what you call evolution (and I call differentiation) within the family does not help you in our discussion. And you are so perturbed by your inability to produce a series of fossils linking one family with another family that you have made statements which you would not have made in calmer moments. One of these is: 'Generally speaking the differences between a family and an allied family is *very much less than* the difference between Equus and Eohippus.' I agree that there is considerable anatomical difference between Eohippus and Equus, but this is true of the most widely-separated members of almost every family. Despite these differences there is no room for doubt that Eohippus is entitled to a place in the family Equidae. Can you name a single book written within the last thirty years in which Eohippus is not included in the horse family?

Marsh, who was the first to find a fossil of Eohippus and gave the fossil this name which means 'Dawn horse,' writes: 'In the structure of the feet and teeth the Eohippus unmistakably indicates that the direct ancestral line to the modern horse has already separated from the other perissodactyl or odd-toed ungulates.'

The great French comparative anatomist, L. Vialleton, who made a special study of the limbs of backboned animals writes: (*Membres et Ceintures des Vertébrés tétrapodes* (1924), p. 682): 'Eohippus of the lower Eocene and Mesohippus of the Oligocene, despite the feet having several toes, are easily seen by the gracefulness and length of their limbs, so different from that of other Perissodactyls, and by the form of the head and the body, to be representatives of the horse family.'

Another great French zoologist, L. Cuénot, writes of (*L'Adaptation* (1925), p. 59): 'Eohippus of the Lower Eocene of the size of a fox, but already a little horse in its general appearance ('aspect global').'

W. B. Scott, a recognised authority on Mammals, writes (*A History of Land Mammals in the Western Hemisphere* (1937), p. 412): 'Eohippus is unmistakably a horse. . . . It is horselike in all parts of its structure, though the equine likeness cannot always be expressed in a description.'

G. de Beer writes (*Embryos and Ancestors* (1940), p. 65): 'The ratio of the dimensions of a five months foetus (of Equus) corresponds to those of an adult Eohippus.'

D'Arcy Thompson writes in his classic book (*Growth and Form*

(2nd. edn., 1942), p. 1081) : 'The differences (between Eohippus and Equus in respect of the skull) are not greater than those between one human skull and another, at least if we take account of the older and more remote races ; and they are again no greater, but if anything less, than the range of variation, racial and individual, in certain other human bones, for instance, the scapula (shoulder-blade).'

From the foregoing you will see that you have exaggerated the differences between Eohippus and Equus. You have very properly given a list of what you consider the chief of these differences, but instead of giving at the same time the chief differences between two selected allied families in support of your contention that these differences are fewer, you invite me to compile such a list and say that if I *cannot do so your point is proved.* You invite me to do that which is incumbent on you, nay to do more, for you have not compiled a complete list of the Eohippus-Equus differences. For me to do this in the case of the civets and cats would involve a journey from Camberley to Regent's Park, spending there some hours in looking up facts and then using some of the limited space at my disposal in this debate in setting forth these facts. I ought therefore to decline your request, but here, offhand, are some of the ways in which the bones of civets differ from those of cats : (1) the ear bones, (2) elongated head, (3) prolonged muzzle, (4) elongated body, (5) short legs, (6) toes usually 5–5 as opposed to the invariable 5–4 of cats, (7) some civets but no cats plantigrade, (8) molar teeth more numerous, (9) number of lumbar vertebrae variable in civets, constant in cats, (10) claws less retractile. Here then are 10 differences, as opposed to 5 (one of which is invalid) listed by you. To justify your assertion that cats and civets are *much less different* than Eohippus and Equus you have to add to your list at least 10 differences.

I will now make a few comments on your list.

(1) Difference in skull. This is disposed of by the words of D'Arcy Thompson, and the fact that the orbit is open behind in some genera of the civet family and closed in others, and this is true of some species of the same genus.

(2) In most families the teeth differ much in the genera of a family, thus in that of the civets, the cheek teeth of the bear-cat are small and rounded, of the Indian civet small, compressed and sharp, while in the palm civet the teeth vary in form and are small in some genera and large in others. As regards numbers some civets

have two upper molars and others one, and this applies to some species of the same genus. I note that you omit to state that in the small Eocene horse, Paloplotherium, the first premolar is usually absent so that this has 'evolved' more than that of the horse of to-day!

(3) The feet are certainly very different, but it is doubtful if Eohippus has splint bones, and the hoof of the stoutest toe, No. III, relatively to the size of the toe, is as well developed as the hoof of Equus.

(4) The degree of fusion of the tibia and fibula is very variable. In some of the beaver family the two bones are quite separate, in others they are fused at the lower end.

(5) The back of Eohippus. Scott considers that it was arched as you describe but Lull gives it no arch at all. I am not prepared to say which view is the right one; but on account of this difference of opinion between experts this feature affords rather slender evidence of change.

As regards the fossils intermediate between Eohippus and Equus, you admit (1) an exact lineage has not been made out, (2) there are gaps in the series, 'but not large enough to be of consequence,' but you do not mention that two are gaps between sub-families! (3) Although you believe Orohippus to be descended from Eohippus 'you could not guess which of the thirteen known species of Eohippus gave rise to Orohippus' which is rather surprising, if the latter be derived from Eohippus.

I gather that your case is this: We know fossils of some 250 species of horses, most of which differ only very little from one or more other species, so that it is reasonable to believe that all the horses are derived from a common ancestor. I agree, as do most of those who reject the evolution theory, that this may have happened. Some, like Vialleton and Le Fèvre, believe this. I do not go so far, because breeders have not been able to produce anything like the changes postulated by this theory, and therefore I deem it essential to await further evidence before forming a definite opinion. I believe that almost every horse of which fossils have been found in America and Europe was an immigrant to the locality in which its earliest fossils occur. The fossils show that the horse family is composed of two well-marked types of horses: (1) those that lived in forests where the ground was soft and often marshy: these horses fed on soft leaves; and in consequence their teeth and toes were adapted to this kind of life. They make up all the three sub-families other than the Equinae. All the early fossils known belong to horses

of this type. (2) Those that lived on grassy plains where the ground is hard ; these fed on grasses impregnated with silica which rapidly wears away teeth. The feet and teeth of these horses were adapted to this kind of habitat. The earliest known fossil of this type appears in America in a middle Miocene rock. It becomes abundant in the Miocene and persists until to-day, whereas the other type became extinct in the early part of the Pliocene period. Are these horses with high-crowned teeth descendants of those having low-crowned teeth ? The known fossils do not enable us to answer this question with certainty, because there is evidence that throughout the Tertiary period there were waves of immigrant horses. The earliest known horses appear as fossils in the Lower Eocene period simultaneously, geologically speaking, in North America and Europe. As no fossils have been found in either continent which can have been the direct ancestors of these animals, it is generally believed that they were immigrant or invading animals. That the middle Eocene horses which replaced them in both America and Europe were also immigrants is proved definitely in the case of one European horse, Palaeotherium, which cannnot possibly be descended from any known earlier horse, because of its great size in comparison with these (one species had the dimensions of a pig, and another those of a rhinoceros), moreover it had only three toes on the fore-feet, as opposed to the four of all other known Eocene horses. It is also almost certain that the first three-toed horse, of which a fossil has been found in America, Mesohippus, and the first horse having high-crowned teeth, Merychippus, are also immigrants, and the probability is that this is true of most of the other newcomers. The fossils tell us that during the Tertiary period the climate in Europe and North America grew progressively cooler, for they tell us that palm trees and crocodiles lived in England in the Eocene period. They also indicate that there was no grass growing in the United States or Europe before the Miocene period. The arrival of the horses having high-crowned teeth coincides with the advent of the grasses.

There are two theories as to the origin of these grass-eating horses that appeared in America, one is that they are immigrants, the other is that they are derived from browsing animals, in consequence of the change of diet resulting from the coming of the grasses, which gradually supplanted the forests ; thus Scott writes (*op. cit.*, p. 200) : 'Because of the minute particles of silica which they contain the grasses are very abrasive and rapidly wear down

the teeth of grazing animals. In adaptation to this new source of abundant and nutritious food supplies many different animals developed a form of tooth which was fitted to compensate by growth for the loss through abrasion.'

Lest it be thought that I am overdoing the amount of migration, let me say that the whole history of plants and animals shows that all along there have been extensive migrations. 'So great,' writes Scott (*op. cit.*, p. 263) 'is the importance of migrations . . . that the history of mammals is quite unintelligible unless such wanderings be taken into account . . . mammalian migrations sometimes involved whole faunas . . . the close similarity of the Lower Eocene animals of Europe and North America is due to migrations in both directions, presumably from Central or Northern Asia.'

If, as I believe, the horses having high-crowned teeth were immigrants to America, this does not settle the question as to their origin. In my view this cannot be done until we know much more of the fossil record in the Far North and Asia.

I do not agree with you that families and orders are 'not things existing in nature but merely artificial conveniences for classification.' They are very definite things, about which there is agreement among biologists in contrast to the disagreement about genera and species. In the case of families the only differences of opinion are in the case of some very big families composed of a number of subfamilies, which some people think should be given the status of families. Every family has very distinctive marks as I have shown in the case of the Equidae. It is only when a fossil consists of a tooth or a bone, or a few bones that there is doubt as to which family it belongs.

As I have already said, the last part of this letter is really outside the scope of our debate, because the dispute is not about modification within the limits of the family. What the evolutionist has to prove is the conversion of a member of one family into a member of another family, and the evolution of new Orders, Classes and Phyla.

You say that the horses are the best example of evolution you can produce. If this be so, you have proved nothing not admitted by many of those who reject the evolution theory. There cannot be less than 2,000 families of animals living and extinct, each one of which, according to you, evolved gradually from some pre-existing family—there are over 230 families of molluscs. Yet apparently *you are unable to adduce any fossil evidence that any one of*

these evolved from any other. Much less the evolution of any Order or Class. I invite you to offer such evidence. I also invite you to name the fossil series which offer any evidence of evolution beyond the limits of the family. My point is that very few of such series have been put forth by transformists and that none of these can bear close scrutiny. If the evolution theory be true hundreds of such series must have existed.

Your bias against what you describe as 'conducting such a discussion by challenges' is understandable, but the whole point of this book is to challenge a dogma which is accepted by the public only because it is unchallenged. I submit that your theory that there is something alien to the spirit of scientific enquiry in the rigid examination and cross-examination of every statement in support of an unproved theory is the very reverse of the truth.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

Before expounding a little of the available palaeontological evidence for evolution I must give some space to your letter. In the first place I will ask you to use terms in their correct sense. I only know of one meaning for the term horse, and that is Equus caballus, the horse as usually understood. This includes a pony, but not a zebra (Equus greyvi), or an onager (Equus onager) or any of the various types of asses (Equus asinus). There is no convention, as in the case of the cats, allowing a wider use of the term. There is a legend that Julius Caesar rode an abnormal horse with three toes. That is correctly described as a multi-toed horse, *and is the only sense in which the term should be used.* Your statement, therefore, that we are considering the descent of a single-toed horse from a multi-toed horse is a gross mis-statement. So far as is known, no horses existed behind the Pleistocene, as Equus stenonis is regarded as an entirely different species. Even if you regard that as a doubtful point, there is certainly nothing behind it which can with the slightest pretence to accuracy be described as a horse. As this is a scientific discussion, it is desirable to use terms in their usual and correctly defined sense.

As I explained in my last letter, Eohippus is an entirely different animal, probably as different as is the tapir. There is no doubt about the difference. Everyone knows this, and the only point in

dispute is the degree of the difference. In trying to elucidate this, I suggested during the original correspondence that, instead of digging up quotations, you should go to the Natural History Museum and examine the specimens for yourself. You have evidently not adopted my suggestion. As I have acted on my own suggestion, your quotations do not interest me. Had you told me that Vialleton had noted subtle anatomical similarities that had escaped my attention, and said in detail what they were, I would have listened carefully. But when you merely tell me that Vialleton talks of the gracefulness of a fossil skeleton, I can only reply that he is using his imagination in a very unscientific way. And when he talks of the length of its limbs, he is talking contrary to the facts. Compared with the horse, the legs of Eohippus are shorter in proportion to the length of the body. Moreover, Eohippus was not built for speed, but was more adapted for walking on marshy ground. (H. 270, 274.)

What Prof. W. B. Scott, who has no more doubt of the occurrence of evolution than I have, and indeed who has written a book to say so, is doing in this galley I do not know. I am very suspicious of quotations by anti-evolutionists, which sometimes give a false impression by taking passages out of their context. Anyhow, as you will insist on giving quotations, which would be quite unnecessary if you would use your own eyes, the following may interest you :

'We have traced the horses back to little animals *whose structure is but remotely equine* and which are *in all respects* so unlike modern species *that hardly any palaeontologist would be bold enough to connect them.*

This is definite enough, and comes from W. B. Scott's *Theory of Evolution*, p. 107. The italics are mine. This quotation is certainly relevant to the problem we are now discussing.

Now let us come a little closer to the degree of the difference. In the same way as you put forward incorrect arguments because of your inaccurate use of terms, so in assessing differences you mistake names for things. You say you have found ten differences between cats and civets to balance my five between Equus and Eohippus, and seem to think that because ten is greater than five, therefore you have proved something. Unfortunately, however, none of your differences are of much importance. Let us take them one by one (and sometimes two by two). (1) I know nothing about the ear bones of Eohippus, and so will pass that for the time being, though I should be surprised if there were no difference. (2, 3) Civets compared with cats have elongated heads and prolonged muzzles. So has Equus compared with Eohippus. (4, 5)

Civets compared with cats have longer bodies and shorter legs. So has Eohippus compared with Equus. (6) Civets toes 5 and 5, cats toes 5 and 4. Compare this with horse 1 and 1 (in each case with two splints) and Eohippus 4 and 3 (in each case with one splint). (7) *Some* civets is not a family difference and anyhow Eohippus is plantigrade. (8) Molar teeth more numerous (how many?), Eohippus had 8 more functional teeth than has Equus. (9) Lumbar vertebrae variable. I do not know the number of vertebrae in Equus and Eohippus, but this is a very variable quantity, and I should be very much surprised if they were the same either in total or in detail. I will, however, point out a much more important difference in the shape of the vertebrae, which I did not previously mention, particularly the long dorsal protuberances. (10) The difference in the claws is balanced by the differences in the hoofs. Thus all but one of your very trivial list of differences are balanced by the *minor* differences between Equus and Eohippus. The really important differences, the whole structural change shown particularly in the extreme difference in the character of the teeth, and in the structure of the limbs, such as the radius and ulna, and the method of jointing, indeed anything of real anatomical importance, has no parallel whatever. The difference between cats and civets is a normal family difference. The difference between Equus and Eohippus is of the kind that exists between different orders, or at least sub-orders.

You really should try to grasp this point and meet it. It is your challenge. So far as the case for evolution is concerned, it does not matter in the least. I do not need this point and am not particularly interested. What does matter is that you have raised the point and should face the issue clearly. If you think I have exaggerated the difference between Equus and Eohippus you should say in what particulars.

In the same way, in speaking of families, you mistake names for things. A good example of this is your making the point that two of the gaps in the Equus-Eohippus series are between two sub-families. Does it matter where they are? The important point is the size of the gaps not their position. But it does not seem to have occurred to you that the reason for the sub-families is the gaps, and though these have been partially filled up since Osborn made his suggestion, they have not been filled up entirely. Osborn was certainly under no delusion that his sub-families were more than conveniences. There is no such thing as a family. It is

merely a conventional classification which works fairly well for living species, but breaks down entirely when we have a nearly continuous series like Equus-Eohippus. In that case you can put the family divisions where you like, and the common sense of modern palaeontologists cuts the knot by not bothering with them at all. I cannot argue this point now, as it belongs to the chapter on morphology, which, according to my scheme, would have come first. I can therefore only assert, and reserve discussion till the proper time. The point to be understood at present is that when I am discussing the degree of the change, it is merely evading the issue to talk about families.

I will bring this tedious discussion to an end with a suitable example of my meaning. Imagine you have in front of you the skeleton of a horse, the skeleton of a hare, and the fossil hyracotherium. Which modern form is the more similar to the fossil? I don't know. *With our knowledge after the event* we can use our imagination and find numerous equine similarities. But the first discoverers had not this knowledge. Hyracotherium was first examined by the foremost anatomist of the day, Professor Owen, who labelled it Hyracotherium lepinorum, implying that it reminded him of the hare. Of course he did not put it in the same family. *He had not the least idea it had anything to do with the horse.* Nor, so far as I am aware, had anyone else until the intermediate fossils began to be discovered. This seems to me conclusive. It is incredible that Owen should have been so ignorant or unobservant as to fail to notice the similarity if the forms were as similar as are even the most widely separated of living animals which are classed in the same family.

I will now pass on from this minor point and try to give some slight idea of the overwhelming evidence for evolution to be found by a study of the fossils, in spite of the fragmentary record. We will first note another lucky find in the Cretaceous. In the case of the Equidae the exact line of descent is difficult to determine because of migrations. There are no such complications in the sea-urchin series worked out by Rowe and others. Here the transition from one type to another is continuous, so continuous indeed that even the species classification breaks down. You cannot say where one species ends and another begins. You have here the 'innumerable transitional forms' you asked for in another connection. The authorities state that a difference of six species is a conservative estimate of the amount of the change, and please note also that

these species are in a linear series, which implies a very considerable change.

Now let us return to the land mammals. There are other series, not so good as the Equidae, but still of some importance, particularly the camels, the tapirs and the rhinoceroses. Prof. W. B. Scott, in his work on evolution, mentions numerous links connecting the camels and llamas with a four-toed creature in the Oligocene. Other series and links can be made out by studying the collection in the Natural History Museum with the aid of the official guide to fossil mammals (which I shall refer to as N.). It is particularly illuminating in the description of the series culminating in the elephants.* In these series, the exact line of descent is more doubtful than it is in the Equidae. We are much in the same position as we were when Hipparion was regarded as a possible ancestor of the horse. We now find it is a side branch descended from a common ancestor of the Merychippus type. All the same, Hipparion is nearly as good evolutionary evidence as if it were the direct ancestor. The same applies to these fossils related to the elephants and rhinoceroses. It does not much matter whether the fossil is directly ancestral or a side branch, the evolutionary evidence is plain.

Where the fossils do not show a sufficient number of stages to be called a series there are *always* links. I do not think an exception is to be found in any group of European or North American land mammals. The *Guide to the Fossil Mammals* (1934) supplied by the Natural History Museum mentions amongst its numerous examples the following :

(1) Ictitherium, from the lower Pliocene, 'an intermediate genus connecting the Hyaenidae with the Viverridae.' (N.24.)

(2) Cynodictis, from the Oligocene and upper Eocene, connects the Canidae and the Viverridae. (N. 25.)

(3) Cephalogale, known as bear dogs. (N.25.)

(4) The fore-runners of the ruminants showing 'the *gradual* acquisition of the typical selenodont molar teeth,' 'the beginning of the gap between the front teeth and the back teeth,' and the '*gradual* fusion of the basis of the two supporting toes.' (N.41, italics mine.)

This is sufficient. It would be tedious to multiply examples. I may give a number of others in an appendix to a later letter.

Let us now turn to the fundamental question of the interpretation of these facts. I will ask you once again to note that I am careful not to overstate, and particularly, with the example of

Hipparion in mind, to dogmatise which intermediate genus is ancestral and which is a side branch. It really does not matter from the point of view of this discussion. *Unless evolution has occurred, there is no sense in the existence of these intermediate genera.* That one might occur occasionally is possible as a matter of chance; but that they occur regularly is a definite proof of evolution.

I would here call to mind the admission I drew from you in the first chapter concerning the distinction between special creation as an explanation metaphysically possible and special creation as a *reasonable explanation.* I shall probably have occasion to bring this up against you more than once, and this is the first instance. I propose to apply this criterion to *all the existing placental land mammals.* You have in the Equidae a series which by a succession of small steps connects two animals so different that they can reasonably be described as belonging to different sub-orders (here again I am careful not to overstate). You have several series of lesser importance. Nearly always where series are missing you have connecting links. Evolution explains all this in a simple and reasonable manner. With the possible exception of man, which will be discussed in detail later, in no case is any gap anything like as great as that shown to have been bridged by small steps in the Equidae, and in the great majority of cases the gaps are very much smaller. Any alternative explanation implying special creation in any form is therefore within these limits *definitely unreasonable.*

Indeed, I do not think we need trouble any further with these placental land mammals. All those found in the lower Eocene are very much alike. In some cases it has been difficult to decide to which type of modern mammal the specimen is most nearly allied. The record becomes more scanty as we pass from the lower Eocene to the basal Eocene, but the similarities are so striking that I think we can assume that the latter are descended from the former. After (or before) this the record is fragmentary, but still secondary mammals are known and different specimens show definite similarities both to the placentals and to the marsupials. I will wait for your reply before deciding whether this obvious point requires further elaboration.

I will conclude with a remark about Vialleton's idea that evolution occurs only within the family. As I have already shown this breaks down with the Equidae, unless you are going to extend the term family to include differences much greater than those commonly understood. It also breaks down in another way, and

this is a point which seems to me to deserve your attention. The proper way to divide into families (if you really must do it at all), is to take the known animals at any period and classify them *without relation to those that follow.* If you will do this with the lower Eocene land mammals, you will find that a number of those which are related to different families of existing mammals would properly themselves be classed in a single family.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

You have more than once suggested that quotations which embarrass you would look very different in their context. Let me remind you that you made a similar assertion about that damning quotation from Lemoine. Lunn then showed you the fourth volume of the French encyclopaedia in which Lemoine says that evolution is 'impossible,' and you discovered for yourself that the context reinforced the quotation.

As to the meaning of the term 'horse' it may interest you that among the meanings given in the *Shorter Oxford English Dictionary* is 'In Zoology sometimes extended to all species of the genus Equus or of the family Equidae.' In fact, apart from you, I know of no zoologist who does not use the term horse to include every genus of the family. The only reason why you do not follow suit is your desperate anxiety to find a series of fossils linking one family with another.

I am well aware that 'family' is to some extent an arbitrary classification, but the different views of present-day biologists are merely as to whether a big well-defined group of animals should be deemed one big family divided into a number of sub-families, or each sub-family be given the status of a family, as in the case of flower-peckers among birds.

You ask me to use words in their correct sense. What you really mean is you want me to use a terminology which you have invented to meet the exigences of your theory.

As you ran away from the challenge about the causes of evolution so have you failed entirely to suggest any plausible hypothesis for transforming a horse having low-crowned teeth into one having high-crowned teeth ; all you are entitled to assert is that a plausible case has been made out for the descent of Equus from Eohippus.

If your assertion that the differences between Eohippus and Equus are much greater than those between the cats and the civets be correct, all you have to do to substantiate it is to set forth in deadly parallel columns the skeletal differences in each case, placing in one column the 30 odd differences between cats and civets, and in the other the differences between Eohippus and Equus. You have not done this, because you know that such lists would show up the utter futility of your contention. I have said that there is a plausible case for the descent of Equus from Eohippus because it is possible to select fossils and arrange them in series suggesting such descent. But I am amused at your unscientific contention that because, although Equus is unlike Eohippus and the fossils suggest that the former is descended from the latter, we are entitled to assume that Eohippus and the tapirs are descended from a common ancestor *in spite of the complete absence of fossils suggesting this*, or linking Eohippus and the tapirs. Your argument may be summarised as follows. A and B had a common ancestor because A is connected with B by a series of fossils. A is not more unlike C than A is unlike B Therefore A and C are descended from a common ancestor!

I had good reason to ask you, as I did, to name similar series to the horse series. The evolutionary tactics consist in producing the horse and vaguely suggesting that there are dozens of other series. There are NOT. The geological record is barren of such series. There are perhaps half-a-dozen of rather lame series (instead of the thousands there should be).

Your tactics are familiar. You are attempting with the potent aid of fashion as an ally to *sneer* creation out of court!

As regards the series (save the mark!) you produce linking one family to another, this time the labouring mountains bring forth merely hot air! You lead off by citing (characteristically without giving it a name), a sea-urchin, where 'the transition from one type to another is continuous, so continuous indeed that even the species classification breaks down.' You doubtless refer to Micraster (with which I will deal later). So far from the changes this displays being from one type to another, the whole gamut is *within the limits of the genus*!!

Then you talk of 'other series not so good as the Equidae,' viz., the camels, the tapirs and the rhinoceroses. But these are in each case a series *within a family*, the families being the Camelidae, the Tapiridae and the Rhinocerotidae. In no case do you mention a single intermediate genus. Then you talk vaguely of 'the series

culminating in the elephants.' Here again not a single member of the series is given ! Thus all your talk of the series you can produce linking one family with another, ends in your saying that series (unnamed) occur *inside* four families ! Finally, you name four genera, each of which you suggest is a link between two families. But a single genus can hardly be described as a series. In any case, so far from being intermediate, each of the three genera you cite *falls definitely within a family*, the dog family in the case of Cynodictis, and the Viverridae in the case of the other two. Finally, you talk of changes in the teeth and toes of 'forerunners of the ruminants.'

Having failed to adduce *any* evidence of changes in animals greater than those which some scientists who reject evolution believe to have taken place, you fall back on special creation. You imply that the problem of creation is a religious one and should be left to the theologians. The truth is that the question whether the various families appeared suddenly or whether it is possible to trace any of them by a true lineage series into another family is a strictly scientific one. It is you whose approach to this problem is quasi-religious rather than scientific. For what is the essence of the scientific method ? Surely research unhampered by *a priori* prejudice and a habit of weighing the evidence. You begin your research with a purely religious faith in evolution. You have already stated (see p. 31) that you do not know the *vera causa* of evolutionary change and that you are not setting out to prove anything (see p. 55). You snatch like a drowning man at any straw of evidence to support your faith and you ignore all that tells against it.

A. The scientist scrutinises the geological record, appraises it, and finds that, even in the case of the Phylum regarding which it is most complete, it has not yielded a single instance of a true lineage linking one family with another family.

B. The scientist is well aware of the fact that a type with certain characteristics of other types is not necessarily a blood relation of the latter. Therefore, transitional forms unconnected with the forms between which they are supposed to be intermediate cannot be adduced as evidence for evolution. Lunn's analogy of the fighter-bomber (p. 18) is very much to the point.

C. The scientist knows that the geological record tells against evolution. He realises that while the horse series of fossils suggests that changes within the family may be considerable, it also shows (if it be a genetic series) that a period of about one-tenth of the

length of that separating the date of the earliest Cambrian fossils from to-day has not been sufficiently long for the evolutionary process to convert one family into another family! From this it follows that the whole period covered by the fossil record is not long enough to permit one Order to evolve into another Order. This is doubtless one of the reasons that led the great French geologist Lemoine to declare that the theory of evolution is impossible. I shall revert to this matter later.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I find it a little trying to be obliged to spend space on trivial side-issues. First let me tell you that none of your quotations embarrass me; but when they come from people who I know take the normal view about evolution, naturally I am a little suspicious. I have no such suspicion about Lemoine, although I think you exaggerate the importance of his remarks. He really did say that evolution was impossible, but I should hardly be inclined to call that damning. I take a more lenient view, and think it probable that, although he has curious ideas about evolution, and is sometimes abusive about it, he may still be a useful specialist in his particular line of investigation, whatever that may be.

You do seem to have scored a minor point about the meaning of the term horse. The *Oxford Dictionary* does say that the term is sometimes used in zoology in an extended sense. That is what I am complaining about. It seems a little foolish in zoology, when accurate terms are available, to use inaccurate terms, although I must admit I sometimes do it myself. The trouble in this case is that it has not come into general use. While most people would understand the phrase 'great striped cat of the jungle' as applied to a tiger, they would be a little puzzled by 'the striped horse of the forest' and would need to think a little before understanding that a zebra was meant. Nor would they refer to the coster's moke as the 'braying horse of the backyard.' I must, however, ask permission to modify my previous assertion. Instead of saying that it is a 'gross mis-statement' to talk of the descent of a single-toed horse from a multi-toed horse, I must substitute 'grossly misleading statement,' and trust that in acknowledging my error I am setting a good example.

I am getting a little tired of your 'challenges.' With regard to the causes of evolution, I have given you quite enough to go on with and have said it twice (see my letters p. 31 and p. 55). As my duty in this discussion is to maintain the generally accepted view that evolution has occurred, it would be out of place to spend much space on difficult and doubtful questions concerning causes, on which the scientific world is not agreed. If I have any space left at the end of the discussion I may say a little more then. In the same way I am not in the least concerned to put forward 'a plausible hypothesis for transforming a horse (?) having low-crowned teeth into one having high-crowned teeth.' While remarking in passing that you will insist in calling an animal a horse which is only one in a Pickwickian sense, I need only say that the stages in the transformation have been observed in the fossils, and that the change has been proved to occur. That is sufficient ; that is what we are discussing ; and I really cannot be troubled to elaborate theories of how and why.

Now let us try to get these horses, real and Pickwickian, out of the way. There are two minor points I should like to mention. One is the hollow and arched back. I cannot insist on the arched back of Eohippus in view of the conflict of authority. But there is no doubt whatever about the disappearance of the hollow back. If you will look at the skeleton of the horse, or even at a good picture (there is a good one in Lydekker H.16), you will see that the dorsal protuberances are long in the anterior region and reduce in size lower down the back. This is one skeletal sign of the hollow back, and is not found in Eohippus. The other minor point is the number of the vertebrae. I should be exceedingly surprised if this were the same in Equus and Eohippus, but do not know where to find the details for Eohippus, so this point must remain unsettled.

With regard to the general question as to whether the difference between Equus and Eohippus can reasonably be described as equivalent to a change 'within the family,' I have clearly shown that it cannot by the example of the cats and the civets. I have shown that all but one of the skeletal differences you mentioned for cats and civets are met by the *minor* differences between Equus and Eohippus, and that the major differences have no parallel. That is sufficient. My point is proved, and I have nothing to add.

A few further remarks are needed about Tertiary land mammals, though I have very little to add about that either. You say that besides the Equidae there are 'half a dozen of rather lame series.'

I mentioned only the camels, the elephants, the tapirs and the rhinoceroses. As I carefully remarked that they were not as good as the Equidae, you can translate this as 'rather lame' if you like. I did not suggest that there were numerous others. Where I suggested the existence of others was in the links, not in the series.

You seem to have some objections to raise to my treatment of this matter, but as so much of what you say takes the form of attributing to me arguments that I did not use, I find difficulty in making sense of them. For example, the reasons you attribute to me for assuming the common descent of horses and tapirs are certainly not mine. Your remarks about 'sneer' and 'labouring mountains and hot air' and 'tactics are familiar' can be dismissed at once as abusing plaintiff's attorney. I don't worry about the abuse, but it makes it a little difficult to discover whether there are any solid arguments mixed up with it. The principal objection seems to be that the genera I mentioned as intermediate are not so, but each 'falls definitely within a family.' To take the example of Cynodictis, the Museum guide I quoted says, 'Cynodictis and allied genera . . . connect the Canidae and the Viverridae.' Is this true or not? If it is, you may place some genera in the Canidae and others in the Viverridae, and it does not much matter where you draw the line. In that case there is no sense in the objection. If they don't connect the families, it is up to you to explain how the Museum authorities went wrong. This is a specialist question on which I am bound to accept authority, and I prefer theirs to yours. That is all the space I can spare for your last letter. If I have missed any solid arguments, I suggest you re-state them simply without rhetoric and without the abuse that makes them difficult to discover.

I will conclude this consideration of Tertiary land mammals by a repetition of the lesson to be drawn from them. We have one very good series—the Equidae—and several other series which you describe as rather lame. We have these other extinct genera, which you object to be called intermediate, but which are described by the best authority in the country as connecting existing families. If this is true, evolution within the family breaks down entirely. So I infer that for all this evidence, of which there is more than I have given, there is only one *reasonable explanation.* Obviously that explanation is evolution. This is in spite of a record (our record) which, though better than usual, is still very incomplete. The evidence for evolution in this important case is all, and indeed

more, than we should naturally expect. I can well leave the matter there.

We will now consider briefly a few earlier fossils. Obviously, as I carefully explained in the last chapter, the record (our record) becomes more fragmentary as we come to earlier times. It would therefore not be reasonable to expect series. There are a few which can be called by that name. I am informed, for example, that both the ammonites and graptolites are rather good, but cannot assert this from personal study. The point is that anything that can be called a series is exceptional, and is only to be expected in very slowly changing organisms in which a lapse of time of a few million years makes very little difference. I shall not now attempt to give a list either of the series or of the links, because some of them relate to forms which I think you will mention in what you term your difficulties. I will conclude with two more examples.

The first is the mammal-like reptiles, or reptile-like mammals (it is not always possible to say which), found in Secondary strata. Two examples worthy of mention are Scymnognathus from the upper Permian and Cynognathus from the lower Triassic (S.357). Both of these show definitely reptilian features. Both show a differentiation of teeth similar to that of mammals. Both show transitional stages between the mammalian and the reptilian forms of jaw and earbones. Our knowledge of these transitional forms of life has been considerably increased in recent years by the discoveries of Broom in Africa. It is not claimed here that series are found ; but as you have given reasons for thinking that in the case of the early mammals the record is very incomplete you are not entitled to ask for series. I am not sure that your reasons are good ones, but we agree about the fact. What *reasonable explanation* is there to account for the existence of intermediate forms between mammals and reptiles ?

The second example is the well-known Archaeopteryx which I mentioned in the last chapter. You objected to my calling it a feathered reptile. I do not insist on the description ; call it a bird if you like. The important point is that it has features belonging to both classes. As it has feathers, and the wings are attached to the body in a general way like those of birds (though there are important differences of detail), perhaps a bird is the best description. Now let us look at the reptilian features. In the first place, it has well developed teeth of the reptilian type, 13 in each jaw. Incidentally, birds with teeth are found also in the upper Cretaceous,

but not later. I would like to suggest that this throws some doubt on whether the bird digestive structures, crop, gizzard, etc., which are so characteristic, and indeed so variable, had been developed. In the second place, while the modern bird has 'pneumatic' bones which combine strength and lightness in a manner so advantageous to a flying creature, nothing of the kind has been found in Archaeopteryx. In the third place, the animal has a long reptilian tail. Of the fifty vertebrae, twenty are caudal, whereas the caudal vertebrae of the modern bird are about six, and these are specially adapted to support its peculiar fan tail. A further fact implying evolution is that there is a similarity between these tail vertebrae of Archaeopteryx and those of the modern bird embryo. A fourth important reptilian feature is the jointing of the bones of the fore limb. In the modern bird the joints of the wing bones are welded to give rigidity. This feature is not found in Archaeopteryx. The claws also can be described as reptilian, and these are not found in modern birds with the exception of the young of one South American species. There are, in addition, a few other minor features which are found in reptiles but not in modern birds.

What possible *reasonable explanation* other than evolution can there be of these extraordinary facts? You have in the last chapter agreed with me that for millions of years after Archaeopteryx feathered creatures existed of which no fossil remains have been found. You cannot therefore raise the difficulty that the earlier stages of evolution are missing. If feathered creatures of which no fossils have been found existed for millions of years after Archaeopteryx, it is not unreasonable to assume that they existed for millions of years before. If we tried to imagine a fossil proof of evolution of birds from reptiles, we could hardly suggest a better one than has been discovered. Anyone who suggests that this form was specially created is open to the Editor's retort that what was created was a tremendous lie. These retorts do indeed come home to roost.

I do not propose now to cite further examples. What is wanted is not a multiplicity of examples, but correct reasoning on those that are well known. As I explained in the last chapter, both logically and historically geology comes last not first, and all that is asked from geology is confirmation. Since the early days of the acceptance of evolution by the scientific world, when the evidence from geology was so scanty as hardly to be said to exist, this confirmation has been found in generous measure. In spite of a

fragmentary record, and of the very small number of workers in this field, further confirmation is continually being added. Certainly there are gaps, and serious gaps ; no one denies it. *But the record which we now have gives us all the confirmation we need.*

I am going to break my rule about quoting authorities on matters of opinion, because of your use of the name of Professor W. B. Scott. Professor Scott, speaking on the evolutionary significance of the geological record, makes the following remark : 'Even as matters stand, the outstanding fact is that so much has been preserved rather than that the story is so incomplete.'[1]

This agrees so well with what I said in the original correspondence about the incompleteness of the palaeontological record, and the marvel that in spite of that we have as much evidence as we have, that it is unnecessary to add anything further.

That is the substance of my case that the geological record gives ample confirmation of the conclusion drawn from other branches of science, that the forms of life existing on this earth have come into existence by evolution. I may add further details later, but what I have given is sufficient. I believe you have some difficulties to bring forward. Perhaps it would be well for us to take those next.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

It becomes more and more apparent that you can only sustain the case for evolution by demanding preferential treatment from the jury. In your first letter you insisted that evidence which is equally valid for evolution and special creation can reasonably be cited as evidence for evolution and against special creation. In your last letter but one you claimed the right to make me produce evidence in support of *your* theory, viz., evidence that civets differ less from cats than Eohippus does from Equus. In your last letter you (i) claim that you have the right to challenge me (i.e., about the civets) and yet complain when I challenge you. Undeterred by your grumbles, I shall continue to challenge you when you make unsustainable assertions. You (ii) claim that anatomical differences that support your views are major ones, while those that support my views are minor ones. You claim (iii) that the jury must

[1] *Theory of Evolution*, p. 86.

(a) ignore over 20 differences between cats and civets, because I offhand mentioned only 10, and (b) hold that these differences do not exist. In short, you claim a novel method of proving a point without adducing evidence in favour of it!

I am glad that you have noted the distinction between an explanation and a reasonable explanation, for my case is that evolution is not and special creation is a reasonable explanation of the phenomena presented by the animal kingdom.

May I put to you in a slightly different form questions already put to you by Lunn?

(1) *Why is it less reasonable to explain the origin of the living world by an act calling into existence a great variety of living organisms than to explain it by the creation of a micro-organism endowed with the power of evolving in the course of millions of years into a great variety of living organisms?*

(2) *Is there anything unscientific or unphilosophic in the theory that the special types of organisms owe their origin to special creation?* T. H. Huxley, at any rate, did not think so (see p. 16).

(3) *If, as you concede, there is nothing intrinsically improbable in the hypothesis of special creation, what is your reason for supposing that the Creator must start de novo with each new creation? Why should God not use certain characters in different combinations?*

Why, in other words, do you assume that Archaeopteryx must be descended from a reptile, because it has certain characters which you deem to be reptilian? Plainly the real difference between us is that my approach to this problem is inductive and yours is deductive. You know (by some private revelation) that the creative acts of God, in whom you believe, came to an end immediately life appeared on this planet, and from this first unproven premise you proceed to deduce your evolutionary philosophy. I go to nature and by an inductive process come to the conclusion that slow, gradual evolution is disproved by the geological record. Whereas you always appeal to the missing links, to the evidence which is not there, my beliefs and my theories about creation are inductions from facts.

You resent my asking you to suggest a plausible cause of evolution. But one of my many reasons for rejecting evolution is that nobody has ever suggested a plausible hypothesis to account for evolution in terms of natural agencies. And it is only when all natural explanations fail that the supernatural hypothesis may be invoked.

I am glad to establish the fact that you cannot and do not pretend to explain the process by means of which things evolved, and that you admit that there are not many series of fossils which are of any use to the evolutionist.

You ask : is the assertion of the British Museum authorities, 'Cynodictis and allied genera . . . connect the Canidae and the Viverridae' true or not ? The answer is : 'Almost certainly not.' Cynodictis and Viverra make their first appearance simultaneously in the same Upper Eocene deposit of Europe. The two genera differ considerably, as may be seen by looking at the pictures of their jaws on pp. 63 and 73 of Zittel's *Palaeontology*, Vol. III (1925). Their teeth differ in form, Cynodictis has three molars and Viverra two. The shape of the jaw differs. If one of these animals gave rise to the other, it must have been by a great mutation. The transformist has to believe that every family is derived from a different family, and, as the Cynodictinae is the sub-family of the Canidae most like the Viverridae, it is supposed to be more closely related to the latter than are any of the other sub-families Therefore, adopting the loose phraseology employed by transformists, the B.M. authorities assert that Cynodictis and other allied genera, i.e., the sub-family Cynodictinae 'connect the Canidae and the Viverridae.' This is a question-begging statement, unworthy of a scientific treatise.

To speak as you do of Scymnognathus and Cynognathus being intermediate between mammals and reptiles and Archaeopteryx as intermediate between birds and reptiles is equally incorrect. *No fossil has been found intermediate between a reptile and a mammal or between a reptile and a bird.* Every palaeontologist knows this. Thus your request for a reasonable explanation of intermediate forms between reptiles and mammals and birds is asking me to account for something that does not exist ! Every form which transformists cite as an intermediate between two Classes is the member of one Class deemed to be the least unlike a member of the other Class. Archaeopteryx is less unlike a reptile than is any other known bird. Scymnognathus and Cynognathus are less unlike mammals than are most other reptiles. To speak of Archaeopteryx as an intermediate between birds and reptiles and the two mammal-like reptiles you name as intermediates between mammals and reptiles is on a par with describing a greyhound as an intermediate between the dog family and the horse, because it is less unlike a horse than is the dachshund ! As to accounting for this, it is inevitable that

in every Class some member must be least unlike the members of another class. You make much of the supposed reptilian characters of Archaeopteryx. Let us examine those you have cited : (1) the teeth, and (2) the long vertebrated tail. Neither of these are characters that distinguish reptiles from other kinds of animal. Turtles lack teeth, and the tail of some of the flying reptiles (Pterodactyls) was as short as that of some modern birds. You cite (3) the non-pneumatic bones of Archaeopteryx ; but the bones of some modern birds are not pneumatic, and those of some pterodactyls were pneumatic. Lastly you cite (4) the jointed fore-limbs of Archaeopteryx. As regards this, let me quote the following passage from Prof. Vialleton's *L'Origine des Êtres Vivants* (p. 109) : 'As to the hand (of Archaeopteryx), the only reptilian features of this is that the metacarpels are not fused at the distal extremity, but this occurs in the ostrich ; on the other hand, the hand could not be bent downwards as every hand is, but only sideways as in the case of true wings. What then is there truly intermediate in Archaeopteryx? It is not its perfectly developed feathers, its bipedalism entirely like that of a bird, or its head which, though provided with teeth, has the shape of that of a bird and the relative proportions of face and brain-case so different from those of reptiles of which the face greatly dominates the infinitely reduced brain-case. Archaeopteryx is a bird, as Dames and Depéret recognised. Its feathers indicate a warm-blooded animal. Its comportment was that of a flightless bird and probably its wings served as a parachute. It was a kind of ratite, an aberrant form, as one can see, but most certainly not an intermediate between *two Classes* (reptiles and birds) as it is often represented to be.' Now, Vialleton was a great zoologist. For forty years he worked at embryology, and he devoted himself in his later years to the study of the limbs and girdles of backboned animals, and as the result of his labours in connection with these he wrote his *Membres et Ceintures des Vertébrés tétrapodes*, published in 1924. As in my case, he when a young man accepted evolution, and his work in the laboratory and the museum, and mine in the field, led him and me to reject the theory. His last book, published in 1929, from which I have just quoted, went through 17 editions within two years of publication, and has done much to cause many French biologists to reject what the French call correctly *Le Transformisme* and we English incorrectly call Evolutionism.

I now come to your imagined intermediates between reptiles

and mammals. As I have already stated, in the Secondary period the reptiles were the dominant vertebrates in the lowlands, where they occupied all the niches now filled by mammals. They were much more diversified than are mammals to-day. For example, some reptiles were as small as a mouse, others were larger than any land mammal, e.g., the Dinosaur Diplodocus, which measured 87 feet from tip of snout to tip of tail. Some of these reptiles had the habits of carnivorous mammals, and had teeth adapted to devouring large quarry, hence the mammal-like teeth differentiated into incisors, canines and molars. These are the creatures which transformists imagine to be the ancestors of mammals. I use the word imagine of set purpose, for in a subsequent letter I shall show that no reptile can possibly have been gradually converted into a mammal.

This lack of transitional forms is not confined to those between reptiles and birds and reptiles and mammals; it extends to all Classes. Let us hear what L. Berg has to say about it. As Berg was a zoologist employed by the Soviet Government, which is pledged to Marxism and officially accepts Darwinism, he can scarcely have a prejudice against evolution. '*It is truly remarkable*,' he writes (*Nomogenesis* (1926), p. 347), '*that palaeontology in no ways displays transitional forms between Phyla and Classes, and, possibly, not even between Orders. . . . Formerly this circumstance was accounted for by the imperfection of the geological record, but it is none the less surprising that the deeper our knowledge penetrates into the domain of fossils the further back recede generic interrelations which, as it were, ever elude our grasp.*' Berg then points out that the alleged transitional forms have been proved to be nothing of the kind, e.g., the lung-fishes as a stage between fishes an amphibians, the Acanthodii as one between the sharks and the higher fishes, the Bennettitales as one between the Gymnosperms (pine-like trees) and the Dicotyledons (flowering plants).

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

This trivial minor points about cats and civets is getting tedious, and I must acknowledge that for the first time I am in a difficulty, but not the kind of difficulty which you sometimes allege. Up to the present I have, on the strength of your reputation as an expert on Indian birds, assumed that, though like myself you are not a

professional anatomist, you had that broad general knowledge of comparative anatomy which makes it unnecessary for me to explain elementary points. Your treatment of this matter throws doubt on that assumption, and I must now be very elementary in order to explain to the general reader a biological question, which, if we had observed a proper logical order, would have already have been discussed under morphology.

First allow me to inform you that no competent comparative anatomist proceeds by the method of listing differences by simple enumeration. It is of no consequence whether you call the differences between the cats and the civets 5, 50, or 500. I will illustrate the principle by the skeletons of a cat, a tiger, and a mongoose. For the purpose of making out a list of differences which are obvious and numerous, the tiger is much more unlike the cat than is the mongoose. Every bone is different in size, and the proportions between length and diameter necessarily vary because of the difference in the weight of the animals. You would do well to read Spencer on this point, or, for a popular exposition, Professor Haldane's short essay, *On Being the Right Size*. Yet, though the differences between the cat and the tiger can be listed to make an enormous number, every comparative anatomist knows that *they are not important* and the comparatively small number of differences between the cat and the mongoose are much more significant.

This same elementary principle applies to the matter in hand. First let me tell you that there are no skeletal differences of any importance between the cats and the civets that have not been mentioned. Second, let me inform you that, as the differences between the cats and the civets (e.g., a mongoose) are important compared with those between a cat and a tiger, so are those between Equus and Eohippus more important still. Indeed, as I showed in a previous letter, the differences between Equus and Eohippus include all the important ones between a cat and a civet, but those to which there are no parallel are still more significant. I don't think any competent anatomist would disagree. I could just imagine it possible that one might argue that, although what I said was obvious on the surface, I had overlooked some subtle points. That is exceedingly unlikely, as, if there were any, they escaped the notice of Professor Owen, but in any case you have nothing to say on this matter, as, if you had, you could settle at once the question of the number of vertebrae. There is no reasonable doubt about the truth of my assertion on this matter.

Your very inexpert handling of this question makes it impossible to take your criticism of the authorities of the British Museum seriously, and the reasons you give for disagreeing are no better than your treatment of the question of the cats and civets. You say: 'if one of these animals (Cynodictis and Viverra) gave rise to the other, it must have been by a great mutation.' No one suggests that one gave rise to the other. The point is that the assertion of the existence of a common ancestor for Viverra and Cynodictis is much more obvious than that of one for modern Canidae and Viverridae, as the latter have differentiated, whereas the former are nearly allied. Moreover, it is a complete answer to people like Vialleton (according to your account, because I know nothing about him except what you tell me), who admit the common ancestor for all the Canidae, and for all the Viverridae, but deny a common ancestor to the two. But as Cynodictis is nearer to Viverra than are some modern Viverridae to each other this does not make sense, and evolution within the family only breaks down entirely. Whatever twists and turns you make, you cannot find any position about evolution which makes sense except that it has occurred and there are no known limits.

Your treatment of the mammal-like reptiles shows the same disregard for the principles of comparative anatomy. Your contention expressed in my language would be parallel evolution owing to similar conditions of life. As you do not believe in evolution, you must translate this into your own language; I can't do it for you. But a mammal-like differentiation of teeth is not needed for a carnivore. It is needed much more for a herbivore. You have only to look at the teeth of a shark to satisfy yourself on that point. Moreover, even if we admitted such an improbability, that would not account for the intermediate structure of jaws and earbones. This is a type of evolution which is exceedingly unlikely to have occurred twice (or to have been created twice for the matter of that). I need hardly say that your comparison of these similarities to those of the horse and the greyhound is even more contrary to the recognised principles of comparative anatomy than those I have already mentioned. The similarities between Archaeopteryx and a reptile are precisely those on which comparative anatomy is based; the similarities between the greyhound and the horse are not. You are not only denying modern evolutionary science, but the principles of comparative anatomy which preceded evolution. Archaeopteryx is intermediate between a bird and a reptile in the strict

anatomical sense, as you half acknowledge by your use of the fighter-bomber analogy, and that it is for convenience classified as a bird is irrelevant. You show in addition other examples of confused thought on the principles of classification ; but these matters I will defer till the proper chapter.

I must now, by the editor's request, deal with your metaphysics. I can't answer your questions because they are all leading questions. The third question, for example, begins : 'If, as you concede, there is nothing intrinsically improbable in the hypothesis of special creation.' What can I do with people who talk like that ? I don't concede anything of the kind. I must therefore say quite bluntly that I regard the hypothesis of special creation as too foolish for serious consideration ; indeed, I do not regard it as a hypothesis at all, but merely one of those peculiar confusions of thought which remove some anti-evolutionists from the class of people with whom it is possible to conduct a rational discussion. If you believe it say so, but why say that I concede it when I don't ? I have therefore to try to imagine what it is you want to know, and the following is my answer. I think the answer really amounts to what is meant by creation, and as it is quite certain that you and I mean different things, I can only say what I mean.

If you ask me how this universe came into existence, all I can say definitely is I don't know. I should probably add : I think it must have been created. You would certainly not understand my meaning. It has nothing to do with science, or with scientific explanation in the ordinary sense of the word ; it is not a hypothesis. It is a metaphysical speculation which takes us out of the region of ordinary reasoning into that of mystical intuition. St. Augustine and others must have thought on similar lines when they postulated the creation of time. My creation means just as much and just as little as does St. Augustine's creation of time. When human reasoning fails we may or may not fall back on mysticism, as expressed by the ideas of God, creation and final causes.

If you ask me how life came into existence, I should give you a very different answer. I should say, *in all probability* it originated by a gradual synthesis of complex organic compounds. If *you* like to say it was another act of creation, my reply would be : very well, keep your mysticism, I don't know enough to argue the matter.

If you ask me how Archaeopteryx came into existence, I have no doubt whatever about the answer. Archaeopteryx and the

stray dog which so annoys you are to me precisely similar. I have not the least doubt that both were born (or hatched) in the ordinary way, although there are many things about birth and reproduction which are to me (and I think to everyone) unfathomed mysteries. Similarly, though there is much I don't know about the causes, I have no doubt that both are descended by the ordinary process of reproduction and change from pre-existing forms : in the one case a reptile and in the other case the generalised early Eocene mammal. We will not trouble now about the earlier stages in both cases.

If you say that Archaeopteryx was specially created, I can only laugh and ask : in the name of God, Christianity and anything else you may happen to believe in—Why ? The suggestion is quite unnecessary, because its descent from a reptile fully explains the facts. More important still, the suggestion seems to me such a travesty of religion. I do not recognise the Christian God in your Mephistopholean Demiurge creating practical jokes. And, when you come to think of it, it would be an enormous practical joke to create a sort of bird and forget to fuse the wing bones. Your demiurge would answer fairly well as a comic Devil in a revised Faust, or book of Job, but I really cannot admit him into the study of biology. You do not even get out of it a literal interpretation of the first chapter of Genesis. If you want that, Gosse has given it to you, and I like his one big lie better than your multitude of little ones. You will, I suppose, call this sneering creation out of court, but it is not creation I regard as out of court, but the inextricable confusion of amateur theologians who mix their categories, which is a worse fault than mixing metaphors. I will try to put this very simply by an analogy. My attitude towards creation is very similar to that of Father Brown on miracles. When the question was put to him he answered : 'Yes, I believe in miracles. I believe in man-eating tigers, but I don't see them running about everywhere.' You and the editor have asked for this, and so you must put up with plain speaking. I think what I have said is what you want to know ; if it is not, I have not the least idea what you *do* what to know.

Well, so much for metaphysics, and I hope I shall not be asked to expound them again until the last chapter. This is supposed to be a scientific discussion, and the title of the discussion is : *Is Evolution Proved.* If you have any scientific objections to allege in the negative, I shall be glad to hear them, as we have had none of any consequence up to the present. You have, I believe, a

number of difficulties connected with geology. Perhaps you will start by stating them without further preliminary fencing.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

In your first letter in this chapter you asserted that the difference between the civet and the cat family is *very much less* than that between Equus and Eohippus. I replied that evidently you were so perturbed by your inability to produce a series of fossils linking two families that you made the above assertion, which you would not have made in calmer moments. Instead of candidly admitting (as you did in the case of my use of the term 'Horse') that in this matter your valour had overcome your discretion, you decided to try to justify your assertion, and in consequence made three unsustainable claims which I dealt with in my last letter. You now add to these three more equally unsustainable claims and make several unjustifiable assertions.

You assert that when classifying animals no competent anatomist proceeds by the method of listing differences by the method of simple enumeration. Far from this being the case, the anatomist, in classifying two animals, starts by ascertaining the differences and listing these. He then appraises the value of each of these differences, and, taking all this into consideration, classifies the animals in question.

Then you make the amazing statement: 'It is of no consequence whether you call the differences between the cats and civets 5, 50 or 500!'

Not content with this, you claim that the greater the number of differences between two animals the closer the relationship, and give as an example a cat, a tiger and a mongoose. The two former belong to the same genus Felis of the Felidae and the mongoose belongs to the Viverridae or civet family. You then assert that the differences between the cat and the tiger can be listed to make an enormous number (despite the fact that they are of the same genus) while although the differences between the cat and the mongoose are comparatively small in number, they are much more significant! But hitherto you have insisted that the differences between cats and civets are not of much importance or of no importance!

Then you drag in Sir Richard Owen, who was born five years

before Darwin, but you do not say how he helps you. Please quote, with reference, the statement of Owen on which you rely. You say you do not think any competent anatomist will disagree with your notion that cats and civets are more closely related than are Equus and Eohippus. I challenge you to quote some statements of competent anatomists to this effect.

Then you chide Vialleton because he does not accept another claim of yours, viz., the lesser includes the greater, because he admits that all the cats are derived from a common ancestor and all the Viverridae are derived from another common ancestor, but not that these two ancestors are themselves derived from a common ancestor!

You crown the above assertions by speaking of 'this trivial point about cats and civets,' but it is you who not only raised it, but have made it the basis of your attempt to produce a series of fossils showing the descent of one family from a different family!

By the way, it is odd that you should be so dogmatic about anatomy and yet admit you know nothing about Vialleton except what I have told you. As you have not heard of, much less read, his classic work, it is useless for me to ask you to name a recent comparative anatomist more competent than Vialleton. I can tell you, however, that de Beer, who is an evolutionist and a F.R.S., spoke highly of Vialleton to Lunn and commended his work on comparative anatomy to J. B. S. Haldane. Your admission illustrates the provincialism of British evolutionists.

I come now to your replies to my three questions, which were put because you evaded them when asked by the Editor. You begin by saying you cannot reply to them because they are leading questions. A leading question is one which suggests the answer the questioner desires or expects, or suggests disputed facts about which the witness is going to testify. In a court of law a man may not put such questions to a witness called to support his case, unless that witness prove hostile, when with the permission of the Court leading questions may be put. You are not a witness on my behalf, therefore I am entitled to put leading questions to you, and the Court would compel you, if the questions were put in Court, to reply to them. In fact, the three questions I have put to you are not leading ones. Not one of them suggests the answer. They are not leading questions but questions you cannot answer. That is why you again evade them. But in the case of Number 3 you have a legitimate grievance, because in putting it I attributed to you a belief you do not hold.

My reason for believing that you conceded that special creation is a hypothesis that cannot be dismissed as intrinsically impossible was based on three grounds. First, you had allowed the Editor's statement to this effect to go by default; secondly, because I credited you with as much insight as T. H. Huxley, who, as quoted by the Editor, said: 'The *a priori* arguments against . . . the possibility of creative acts appear to me to be devoid of reasonable foundation.' Thirdly, I assumed that you would admit that a philosophic theory held by a large number of men of great philosophic and scientific attainments was a sufficient ground for assuming that this hypothesis cannot be sneered out of court.

I am greatly obliged to you for having made your position crystal clear in the following words: 'I regard the hypothesis of special creation as too foolish for serious consideration; indeed, I do not regard it as a hypothesis at all, but merely one of those confusions of thought which remove some anti-evolutionists from the class of people with whom it is possible to conduct a rational discussion.' This statement of yours I find very gratifying for two reasons. First, it contrasts so well with the following pronouncement which occurs on page 365 of Vialleton's *L'Origine des Êtres vivants* (1930): 'Le mot création qui avait été bani du language biologique doit y reprendre sa place, au moins pour bien marquer le fait indubitable que le monde nous est donné comme un ensemble coordonné et par consequent voulu à quelque moment et dans quelque parties qu'on le prenne. Le mot transformisme doit être abandonné parce qu'il désigne une théorie dont l'impuissance à donner ce qu'on lui demandait est manifeste.'

Secondly, your reaction to the theory of special creation seems to me to resemble that of the proverbial bull to the proverbial red blanket. It shows that you and Prof. D. M. S. Watson belong to the same school of thought: you accept evolution, not on its merits, but because you cannot stomach special creation.

Being quite unable to answer my questions 1 and 2, which are very plainly put, you affect to be unable to understand them, and say you will try to imagine what I want to know; and then you put to yourself two questions made up by you and answer these! This part of your letter does not need my attention, but you do deal with my question as to why you suppose that the Creator must start *de novo* with each new creation, with Archaeopteryx as an illustration. You say the descent of Archaeopteryx from a reptile fully explains the existence of Archaeopteryx. This would

be a fairly satisfactory answer if you could (1) explain how feathers could have evolved gradually (which you have failed to do); (2) say positively from what Order of reptiles Archaeopteryx has been evolved (which neither you nor anyone else can do); and (3) you could produce a series of fossils linking Archaeopteryx with a reptile (which you cannot do). You therefore make the best of a bad job by saying you regard Archaeopteryx as a practical joke.

The creation of a bird of which the wings act as a parachute and the claws on the free digits of the wing enable it to grasp the branches among which it climbed is no more a practical joke than is the flying squirrel. As to why it was created, you might learn some natural history by reading Paley's *Natural Theology* as an antidote to Spencer's books on zoology. Paley, like Cuvier, appreciated the marvellous variety of the animal kingdom, and said (p. 170) this might 'induce us to believe that VARIETY itself distinct from every other reason, was a motive in the mind of the Creator or with the agents of His will.'

TESTIMONY OF THE GEOLOGICAL RECORD

In the remainder of this letter and those that follow I propose to set forth five important items of the testimony of the geological record against the evolution theory:

I. A great and diversified marine fauna appears on the scene with startling abruptness at the beginning of the Cambrian Period.

II. Every new type of animal appears suddenly in the geological record, endowed with all the attributes by which it is characterised. The changes it undergoes afterwards are comparatively insignificant. Sometimes, however, a group of animals about to become extinct undergoes considerable changes of a pathological nature before it disappears from the scene.

III. So far it has been found impossible to produce a series of fossils showing that one Family has gradually become converted into another Family, or an Order, Class or Phylum into another.

IV. While it is open to doubt whether or not the geological record furnishes good evidence of one genus having been converted into another, it certainly shows (1) that a large number of genera have persisted unchanged during long periods; (2) in the cases where the record enables us to trace far back into the past, two or more genera of a Family, their lines, instead of converging

until they meet in a common ancestor, seem to follow a parallel course.

V. While the record indicates that some species have changed into other species, it also suggests that some species are exceedingly stable and have persisted during an immense period of time.

In this letter I will deal with item No. 1.

A great and diversified fauna appears on the scene with startling abruptness at the beginning of the Cambrian Period.

Many of the Pre-Cambrian rocks which immediately precede the Cambrian rocks and underlie them are rocks in which fossils could equally well have been deposited, but not a single undisputed fossil has been found in them.

Suddenly in the Cambrian Period we find the sea full of highly organised types. We find nothing which suggests slow evolution. We find no experiments in the production of new types, no experiments, for instance, in shell making. The first shells are fully developed. We find these earliest animals as sharply differentiated into Species, Genera, Families, Orders and Phyla as they are to-day.

These earliest fossil-bearing rocks—those of the Cambrian period—are wide-spread. They occur in several places in England, in Wales, in Scotland, in many localities in Europe, in Alaska, Eastern Canada, Newfoundland, Australia, China and Siberia, and they are wide-spread in the U.S.A.

So varied are these earliest known fossils that they include members of all the great Phyla that possess hard parts, except the backboned phylum, of which the earliest known fossil does not occur earlier than the later part of the Cambrian Period. All belong to existing Phyla and Classes, some to existing Orders and Families, a few to existing genera, but only one seems to be of a species now living. These fossils, in the words of Brooks (*The Foundations of Zoology* (1899), p. 216), 'far from showing the simple unspecialised ancestors of modern animals are most intensely modern themselves in the zoological sense.' Were it possible for anyone now living to take a boat with a drag-net on a Cambrian sea, the net would catch creatures, many of which the non-expert would find it difficult to distinguish from those in a haul he would make to-day; animals like present-day mussels, limpets, lamp-shells, sponges, jelly-fishes and sea-cucumbers, but his net would contain in place of shrimps, crabs and lobsters, trilobites (creatures looking like great wood-lice), and the lamp-shells would be more numerous instead of less numerous than molluscs.

Many of the Pre-Cambrian rocks have been so metamorphosed and disturbed that any fossils they may have once contained would have been destroyed, but this does not apply to a number of these early rocks, which remain to-day just as they were deposited, beautifully preserved and eminently fitted to hold and retain fossils. It is these that have been so keenly searched in the hope of discovering fossils in them. And some enthusiasts have found in them what they believed to be fossils. But, to quote Percy E. Raymond, formerly President of the Palaeontological Society of America (*Bul. Geol. Soc. Amer.* (1935), pp. 375–92) : 'so anxious are geologists to obtain fossils from these rocks that anything which remotely resembles an organism is carefully saved and studied in great detail. Although many such objects have been described, very few have been unreservedly accepted as fossils.' Raymond, after a careful scrutiny of all these supposed fossils, accepts none of them unreservedly ; he thinks that two of them may eventually prove to be fossils, but judgment should be reserved until further specimens shall have been found.

Unless this lack of fossils in Pre-Cambrian rocks can be accounted for in a way compatible with the theory of evolution, this must remain an unverified hypothesis. I have come across about a dozen explanations of this absence of Pre-Cambrian fossils, each incompatible with all the others, and all in my opinion, untenable. What explanation have you to suggest ?

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

In my first letter of this chapter, as you say, I stated that the differences between cats and civets was much less than that between Equus and Eohippus. In my subsequent letter, pp. 94–95, I showed that all but one of the significant differences between cats and civets were paralleled by the *same* differences between Equus and Eohippus, and that the most important differences between Equus and Eohippus had no parallel. *That is the proof*, and nothing that you have said since controverts it in any way. The best reference I can give you for Owen's discovery is H.269.

About your three questions, although I think I have given you the necessary information, perhaps I had better answer them directly, so far as is possible, in order to give you no possible excuse

for saying that anything you have to put forward has been evaded. The answers are as follows: (1) Because one absurdity is better than a million absurdities. (2) Yes. (3) I cannot give you any reason why God should not do anything. This is supposed to be a scientific discussion.

Huxley's opinion and my own are identical. In order to understand Huxley on this matter, it is necessary to read his works, and particularly his essay on *Possibilities and Impossibilities* (*Collected Essays*, Vol. 5, pp. 192 seq.). The following illustration may make the point a little clearer. When you see a conjurer take a rabbit out of a hat, it is a *possible* explanation (in the sense of conceivable), that the conjurer has created the rabbit. But it is highly *improbable*. It is also unscientific and unphilosophical to assume that he has done so. You seem to regard impossible and improbable as convertible terms. In Huxley's language (and in mine) they are not so.

With regard to the rest of your letter, I will first ask you for your authority for the statement that vertebrates are found in the upper Cambrian. The rest of this letter will deal with the one point you have elaborated at length, namely Pre-Cambrian fossils. With regard to that, I will say at once that your main statement of fact is not disputed. The traces of life in the Pre-Cambrian are very much less than those found in the Cambrian. There is no doubt of the existence of traces of life in the Proterozoic. In the Archeozoic there is nothing but graphite, which is probably of organic origin, as we know of no other natural source for the element carbon. But there is no doubt about the great difference between the Pre-Cambrian and the Post-Cambrian record (our record).

I cannot see that these facts are in any way surprising. I explained in the last chapter how fragmentary the record is, and how it becomes more so as we go back in time. It is, therefore, to be expected that, before a certain time, fossils shall become rare, and finally cease altogether, which is exactly what happens. The point is perfectly valid, and, for what it is worth, I concede it. You do, however, exaggerate the amount of Pre-Cambrian sedimentary rocks which are available. Any book on geology will warn you on that matter. For example, Geikie, in his text-book of geology says, 'Rocks have been claimed as Pre-Cambrian which are certainly eruptive masses of later date' (p. 882). Gregory and Barrett (*Stratigraphy*, p. 43) says: 'Rocks have been called Pre-Cambrian because they have no fossils.' Also I think due regard should be

paid to the indurated nature of the bulk of the rocks that are undoubtedly Pre-Cambrian. This implies that any fossils that might have been there are more than usually likely to have disappeared.

As we go back in the history of the earth there was a time when the animals had no hard parts. It may be that that time was not long before the Cambrian, and that the early stages of the formation of hard parts occurred in the considerable period that elapsed between the Lower Cambrian and the known Pre-Cambrian. Of that, however, we cannot be sure, and earlier fossils than those now known may be discovered at any time. There the question must be left, and it is no use speculating.

APPENDIX

(Further evolutionary evidence from the land mammals.)

1. The Eocene Miacidae, classed as Creodonts, resemble 'partly the Viverridae and partly the Canidae and Ursidae, being probably the common ancestor.' (Zittel).

2. The earliest fossil forms of the Mustelidae (pole-cats and weazels) are not markedly differentiated from the earliest Viverridae, 'from which they are probably descended.' (Zittel).

3. The early Eocene mammals are divided into creodont and condylarthrous animals, 'the exact boundaries of which are badly marked in early times.' (M. 102).

4. The upper Eocene lemurs Adaptis combine features of existing lemurs and apes.

5. The Creodonts are not easy to separate absolutely from the existing and more especially from some of the extinct members of the Carnivora Vera. (M. 455).

6. 'The progress is so gradual that the forms enumerated and described seem to have been part of a continuous series culminating in the ground sloth of later times.' (M. 193 on Edentates).

7. Beddard thinks Allotheria a possible ancestor for both Monotremata and Marsupials. (M).

8. Arsinotherium (lower Oligocene Egypt) is allied both to the Amblypoda and the Hyracoidae. (N. 55).

9. 'Tritylodon longaevus was originally described as a mammal by Sir Richard Owen, it was later placed among the reptiles by Professor Seeley, but the most recent workers include it among the mammals.' (N. 81). Which is it? Why should some Mesozoic

mammals and reptiles be so similar on any other ground than that of evolution?

10. Palaeotherium magnum was classified by Cuvier in the Tapiridae. Modern authors have removed it from the Tapiridae to the Equidae. (N. 35). Owen regarded Hyracotherium as related to Chaeropotamus, which is now regarded as related to the Suidae (pigs), it has also been regarded as related to Lophiodon (Tapiridae), see H. 269. This illustrates the fact that the early Eocene ungulates are so nearly allied that they may be regarded as a family, and so evolution within the family really means a common ancestor for all ungulates. Items 3 and 5 also show that similar reasons may be given for regarding ungulates and carnivores in the same light. There is thus very little doubt of the common origin of all living and extinct land placentals.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

'I cannot,' you write, 'give you *any reason* why God should not do anything. This is supposed to be a scientific discussion.' The operative words are italicised. You decline 'reasons' but you are prodigal of assertions about the absurdity of any conception of God which you find difficulty in understanding. I quite agree that this should be a scientific discussion. But we who do approach this problem of the living world in a scientific and inductive[1] manner find ourselves confronted by people like you and Watson who accept evolution not because you have any hope of proving it to be true but because you assert (without, of course, giving 'any reason') that special creation is incredible. In effect this controversy is a controversy between science and pseudo-religiosity, between the scientific demonstration that new types appear suddenly and the pseudo-religiosity which refuses to draw scientific deductions from the clear evidence of the geological record.

The difference between us is that my beliefs are based on reasoned inductions from the evidence and you concede in effect that your creed starts from the premise *Credo quia absurdum est.* You

[1] By induction I mean arguing from the particular to the general, and by deduction arguing from the general to the particular. Your letters are deductions from the unproved premise that evolution has occurred. You began by assuming the truth of evolution. So did I, but my inductions from the particular, from the facts of nature which I observed, led me to the conclusion that these facts can be explained only by creation.

believe in God and in creation, but you prefer to believe that creation antedated the appearance of life on this planet because, 'One absurdity is better than a million absurdities.' I disagree. If my own belief rested on absurdities, whether one or many, I should not attempt to defend it against a rational opponent. I hold on the contrary that there is nothing absurd in the concept of creation or special creation, and that the question as to whether new types appeared suddenly on this planet or evolved gradually is strictly scientific and should be discussed without dragging in your emotional prejudices in favour of your particular pet absurdity. My own beliefs about God are in the main inductive, that is they are suggested to me by the available evidence and the only *a priori* assumption which I am prepared to make is that Charles Kingsley was correct when he avowed that he could not believe that God would write on the rocks 'one enormous and superfluous lie.' A God who played such practical jokes on the earnest seeker after truth, creating a world with the appearance of a planet in which a great and diversified fauna appeared suddenly, when in fact this had come into being by a slow process of evolution, would be no God for scientific men to worship.

It is true that as we pass back in time the quantity of fossiliferous rocks that have been preserved diminishes to some extent, but there is no question of the Palaeozoic fossils gradually tailing off. In the Cambrian rocks they are numerous and greatly diversified. Suddenly we come to a stage when they are *no longer found anywhere in the world.* Underlying the richly fossiliferous Cambrian rocks are vast masses of rocks in which not a single indubitable fossil has been found, rocks thousands of feet in vertical thickness and in many places identical in all their physical features with the overlying Cambrian rocks into which they fade imperceptibly, rocks beautifully preserved, undisturbed, unmetamorphosed, eminently suited to hold and retain fossils.

There is no justification for your statement : 'the considerable period that elapsed between the Lower Cambrian and the known Pre-Cambrian.' Doubtless, as in the case of all later rocks, in some places there has been a time gap between the deposition of a formation and the one overlying it, but these gaps are all *local affairs* and the result of local conditions. If the known Cambrian rocks were all confined to one locality there would be something in your explanation, but as Cambrian rocks have a world-wide distribution it is of no avail.

As regards cats and civets, you still decline to produce that long list of anatomical differences. You prefer assertion to facts. But the fates are unkind to you ; a few minutes ago, I happened to come upon the following on page 621 of Scott's latest book, already mentioned by me : The 'highly distinguished palaeontologist Dr. Max Schlosser' was 'so impressed by the isolated position of cats that he thought they must have arisen independently and separately from all other fissipeds (land carnivora) and denied any relationship with the Viverridae (civets) !'

You have not given Owen's statement on which you rely.

In reply to your query re the earliest Cambrian vertebrate fossil I refer you to W. L. Bryant's account in the Fifteenth Biennial Report, Vermont State Geologist (1926).

Your appendix consists of the efforts of a number of transformists to find ancestors for animals or groups of these. 'When one is a transformist,' writes Maurice Thomas, 'one has to assign an ancestor to another animal some creature even if it be a beast of the Apocalypse.' As I have already considerably exceeded the space allotted to me for these opening chapters I make the following sporting offer. If you will transfer to me 1,000 words of your quota, I will pull your appendix to pieces, item by item. Meanwhile in reply to your query re Tritylodon. At present we know only an incomplete skull without lower jaw. When we learn something of its skeleton we shall be able to classify this animal.

I now come to the second item of the testimony of the geological record against the evolution theory.

II. Every new type of animal appears suddenly in the record with all the attributes by which it is characterised.

Take the fishes. The earliest nearly complete skeleton known reveals that the fishes then living had typical fish bodies, tail and backbone. They show not the least resemblance to any other phylum ; so much so that there is no agreement among transformists as to the Phylum that is supposed to have given birth to vertebrates. Later new Orders of fishes appear, but no transitional forms between them and the earlier fishes. In the Upper Silurian scorpions appear suddenly, hardly distinguishable from those now living. So is it with spiders which appear in the Carboniferous, provided with complete web-spinning apparatus. Insects show the same thing. One of the earliest known is the blackbeetle so common in old houses : another is a typical dragon-fly.

So is it with the turtles. These are unique among mammals and undergo no noteworthy modification in structure since their appearance in the Trias. The extinct marine reptiles called Ichthyosauruses tell the same story. These differ as widely from other reptiles as whales do from other mammals. The same story is told by the Pterodactyls, extinct flying reptiles as different from other reptiles as bats are from other mammals. The earliest known Pterodactyls have fully-developed wings.

As regards birds, we have noted that Archaeopteryx appears unheralded in the Jurassic. All the highly specialised types of mammals, the cetacea (whales, etc.), the Sirenia (sea-cows), the Pinnipedes (seals) and the bats make their first appearance in a fully-developed condition.

Please note that each of the above Orders or sub-Orders that appears upon the scene so abruptly remains almost entirely unmodified from the time of its appearance until the present day or until it becomes extinct. Is it reasonable to assume that each group underwent tremendous modifications, nay transformations, in localities unknown to us, and, after they show themselves, remain static?

Please note also that not a single fossil has been found transitional between any of these and its supposed generalised ancestor.

In order that those who are not biologists may appreciate the magnitude of the difficulty to evolution presented by the lack of intermediate fossils, let us look into the matter of the marine reptiles and mammals which evolutionists assert are derived from land ancestors: Ichthyosauruses, turtles, whales, sea-cows and seals. *Ex hypothesi* these all evolved on the fringe of the sea, i.e. the locality of which the geological record is the most complete. Yet not a single transitional fossil has been found in the case of any of these. Take the seals, walruses and sea-lions which appear in the Miocene period. There must have been at least 10 genera intermediate between the first seal and its hypothetical dog-like ancestor, and a further 9 linking the three families of Pinnipedes now existing with the parent or first seal, making 19 intermediates in all. As fossils of more than three-fourths of the living genera of Pinnipedes have been found, fossils of 14 or 15 of these intermediate genera ought to have been discovered. Not merely 14 or 15 fossils, because several specimens ought to have been found of some of these genera. Thus, if seals gradually evolved from land animals, we might reasonably expect to have found by this 50 intermediate fossils. Fossils of

living genera of Pinnipedes have been found in England, Scotland, Norway, Holland, Belgium, France, Italy, Germany, Austria, Hungary, South Russia, in Oregon, Virginia, Maryland, New Jersey, also in Egypt, Victoria and New Zealand. In view of facts such as these, there seems no alternative but to believe, that, however the Pinnipedes originated, their origin must have been sudden. In the case of so diversified an order as the Cetacea the intermediate fossils that ought to have been found should have numbered about 300, linking the first whale with its land ancestor, and connecting with one another its three sub-orders and eight families. Not one has been found. Taking also the Sirenia, turtles and Ichthyosauruses in all some eight or nine hundred fossils of genera intermediate between them and their hypothetical land ancestors ought to have come to light.

Nor is this all. Each of these groups does not appear in the form of a single species or genus, which for a long period is the only representative of the group. Several genera of each appear practically simultaneously: 9 Ichthyosaurs and 6 Chelonia in the Trias; 5 genera of Sirenia and 6 of Cetacea appear in the Middle Eocene; 6 genera of the Pinnipedes in the Miocene. Yet not a single fossil of any of these occurs in the early Trias in the case of the two reptiles, the early Eocene in the case of the Sirenia and Cetacea, and the early Miocene in the case of the Pinnipedia. Do you believe that the fossil record is so good at the time each of these groups appear and afterwards, and so bad before the appearance of each? Do you believe that the fossil record of the Lower Miocene is bad in the case of the seals and so good in the case of the Cetacea as to yield fossils of ten genera of these?

I put it to you that the fossil record tells us plainly that the supposed ancestral forms of all the above groups exist only in the imagination of transformists. I contend that no theory of origins that demands such intermediate forms is tenable.

III. So far it has been found impossible to produce a series of fossils showing that one Family has gradually become converted into another Family, or an Order, Class or Phylum into another.

This need not detain us long, for you have not been able to produce this series despite your gallant attempts to convert Eohippus into an Eohippopotamus!

IV. While it is open to doubt whether or not the geological record furnishes good evidence of one genus having been converted into another, it certainly shows (1) that a large number of genera have persisted unchanged during long periods. (2) In cases where the record enables us to trace far back into the past two or more genera of a family, their lines, instead of converging until they meet in a common ancestor, seem to follow a parallel course.

As I am trying to discover the extent to which animals can be changed, I have endeavoured to find a fossil series showing the gradual transformation of one genus into another. So far I have not succeeded. All you can produce is one doubtful case, the Equidae, which we have already discussed in some detail.

You imply that the total lack of fossils linking genera of mammals is due to the fact that most of the rocks in which these occur cover a period of short duration, speaking geologically. But in deposits such as those of the Phosphorites of Quercy, which are so rich in fossils and cover the Upper Eocene and Lower Oligocene periods, no such series of fossils has been found. This can only mean that, either new genera do not originate gradually, or, if they be products of evolution, the process is exceedingly slow—something like from 5 to 10 million years for the evolution of a genus of land mammals. If it takes so long for a genus to evolve, the evolution of a Family would require from 50 to 100 million years and that of an Order 500 to 1,000 million years. The earliest indubitable fossil was laid down about 500 million years ago. So you see that the fossils are not exactly favourable to the theory of evolution !

As I have been able to find no record of a series linking one genus of mammal with another genus, *if you know such a series I hope you will name it.*

Long-lived Genera

Some idea of the length of time during which most genera of molluscs are known to have existed without appreciable modification may be gathered from Table VI (p. 71). Table VII (see appendix to this letter) gives some information in the case of the other Phyla. Table VIII gives a few instances where the fossils show that two or three genera of a family have existed for from 100 to 340 million years and have run a parallel course and cannot be traced to a common ancestor.

That the fossils show that many genera in coastal seas have undergone no modification for an immense period of time suggests that those inhabiting the sea far from the land are equally long-lived, and the reason why fossils of *all* living genera of molluscs have not been found in the Cambrian rocks known to us is that in the Cambrian period their habitat was the open sea, and they did not move into coastal waters until comparatively recent times. The fact that 31 genera of molluscs now living in and around the British Isles existed in the Carboniferous period, i.e. some 250 million years ago, renders it not unreasonable to suppose that these lived in the open seas 250 million years before they migrated into coastal waters.

V. While the geological record suggests that some species have changed into new species, it shows that some species are very stable and have persisted during an immense stretch of time.

The stability of species is shown by the fact that in the case of molluscs 84 per cent of the species now living have left fossils dating from the beginning of the Pliocene Period, which, according to the current method of dating rocks, was 15 million years ago. Thus while the fossil record *proves* that many species are very stable it only *suggests* that, if allowed sufficient time, a species may change into a different one.

Yours sincerely,

D. DEWAR.

APPENDIX

TABLE VII

LONG-LIVED GENERA

Phylum	Period in which earliest fossil has been found.	Date in millions of years. B.C.
Mollusca	Cambrian	500–400
Protozoa	Cambrian	500–400
Brachiopoda	Cambrian	500–400
Arthropoda	Ordovician	400–350
Vermes	Ordovician	400–350
Echinodermata	Triassic	190–150
Coelenterata	Triassic	190–150
Vertebrata	Triassic	190–150

TABLE VIII

OF LIVING GENERA
PARALLEL LINEAGES WITHIN THE FAMILY

Family.	Genus.	Period in which earliest fossil has been found.	Years ago (in millions)
Nuculidae	Nucula	Silurian	340
(Nut-shells)	Acila	Cretaceous	100
Pinnidae	Pinna	Jurassic	140
(Wing-shells)	Cyrtopinna	Jurassic	140
	Atrina	Carboniferous	250
Pectenidae	Pecten	Triassic	170
(Scallops)	Hinnites	Triassic	170
	Amusium	Jurassic	140
Mytilidae	Mytilus	Triassic	170
(Mussels)	Modiolus	Devonian	300
	Lithophagus	Carboniferous	250

DEAR DEWAR,

As the editor asks me to make this my last letter in the present chapter, perhaps I may be excused if I am a little discursive. It will be best first to say a little more about your metaphysics. You seem to find inconsistency between accepting creation in any shape or form and declining to accept your somewhat peculiar ideas on special creation. If that were so I should merely ask you to ignore anything I said on creation, as that is a somewhat vague metaphysical speculation irrelevant to the issue. When we get beyond the range of our very limited human knowledge it is a natural human reaction to speculate on creation and final causes. To a certain extent this is legitimate, but it is not legitimate within or near the bounds of ordinary knowledge. It does not seem to me allowable to fall back on creation because we find difficulty in finding the exact line of descent of living creatures. The postulation of creation ends the discussion. There is then no more to be said or known. In my view, however, we are only at the beginning of our study of the subjects implied in this discussion. This is particularly the case with palaeontology, in which very little has been thoroughly examined even of the evidence that is available, to

say nothing of the difficulty that we do not know how much has been irretrievably lost because the fossils are not there to be discovered. It is no doubt true in a sense, as you say, that whether or not forms of life appeared 'suddenly' is a scientific question, but we are nowhere near the detailed knowledge necessary to consider that at all. We have quite sufficient evidence to say quite definitely that some types, e.g. land mammals have *not* appeared suddenly, in other words have been evolved. With regard to other types—the majority of types—geology gives very little evidence. So far as geology is concerned *we don't know*. That is all that can be said, and we must proceed to other types of evidence. Your mistake lies in making inferences from ignorance. It is quite illegitimate to infer creation from ignorance, which is what you are doing all the time. It is quite conceivable that geology might give *positive* evidence against evolution, *but not a trace of such has ever been discovered.* At least, if you think you have any such evidence, you have reserved it till your last letter to which I shall not be able to reply.

That is the substance of what I have to say. The rest is elaboration, which is desirable because politeness demands that I pay a little attention to the details of your last letter. The first detailed point is the difference between the Cambrian and the Pre-Cambrian. The difference is admitted in a general way, but, when you have a legitimate point to put forward, you exaggerate. In the first place I must insist on disagreeing with you on the question of the continuity of the two series of rocks. In most cases, including the Canadian series where most of the fossils have been found, there is no doubt whatever that they are discontinuous, because they are unconformable. In a few cases, such as Australia, there is no obvious uncomformability. This does not prove continuity, it merely proves the absence of mountain building in the time between the deposition of the two series. This merely makes it more difficult to prove discontinuity, which can, however, sometimes be done. You need to study a good text-book on geology on this matter. The most that you can legitimately say is that, *in a very few cases*, the question must be left open. You are not entitled to assume continuity of deposition *in any case*. The only proof in geology for approximate continuity of deposition is similarity of fossils. Next there is no reasonable doubt about the geologic evidence for Pre-Cambrian life. I have had the opportunity of examining some of the specimens. The worm casts, for example, are very like later worm casts, and the worms are rather big. The carbonaceous

remains are very like those in later strata, attributed to algae, though they are too carbonised to enable species to be discovered. I am inclined to think that careful microscopic research might get us further even with these. The fossil remains are indubitable but not recognisable, if I may put it in that way. The main point you put forward is a good one, and quite legitimate, but I do not think you help your case by exaggerating. All through the strata unfossiliferous rocks are continually found both over and under the fossiliferous ones, there is nothing exceptional in that. Still, for what it is worth, I gladly concede to you the fact that, *so far as our present knowledge goes*, the transition from recognisable to unrecognisable fossils is a little abrupt, and I am pleased to be able to congratulate you on finding one really relevant argument.

With regard to the fossil record as a whole, the answer to all you said in your last letter is found in the last chapter. The geological record is fragmentary, and so *it is entirely illegitimate to make inferences from the absence of fossils*. If you want further evidence for this, I would suggest you read the Introduction to Zittel (1913 edition) which explains in some detail how and why the fossils which are 'laid down' do not remain. With this fragmentary record in our minds, let us look at one of your italicised passages : 'Every new type of animal appears suddenly in the record with all the attributes by which it is characterised.' I find considerable difficulty in making sense of this. What does it mean ? What is meant in the first place by the record ? If you mean our record, the fossils do not appear at all. They have to be very carefully got out of the rocks, collected and classified. If you mean by record the fossils that are in the rocks the statement is meaningless. *We don't know what fossils are in the rocks*. We only know what we have found. Obviously a new type of animal has all the attributes by which it is characterised, otherwise it would not be a new type of animal. What do you mean ? You surely do not mean that Eohippus has all the attributes of a zebra. It is really excusable if I am inclined to infer that your exposition is so vague and confused because of the confusion of ideas, and that it is because of this confusion that you are an anti-evolutionist. Now let us look at another instance when you seem to fail to follow, or even to attempt to answer, a very simple piece of reasoning. Let me once more put this question of the cats and civets in the simplest manner possible :

1. In your letter (p. 89) you give a list of the skeletal differences between cats and civets, and suggest that there are many more.

I inform you (p. 112) that there are no more *of any consequence*. You have not stated any more.

2. I show you in my letter (p. 94) that all but one of these are paralleled by the *same* differences between Equus and Eohippus, and that the most important differences between Equus and Eohippus and not paralleled by any differences between cats and civets.

What further proof does anyone want? Now let us look at your reply this time. You say on the authority of Max Schlosser that the cats are unusually isolated. Very well; I have no objection; all the better for my case.

It is also not true that I raised this tedious matter. In your letters (p. 51 and p. 53) you stated that I had only to prove this point in order to convince the editor and make you modify your position. The point is proved, but I have still to hear from you and the editor that the promised result has followed.

Your reply on the subject of Tritylodon is equally inconsequent. You say the fossil is incomplete—a skull without a lower jaw. Does that appreciably affect the value of the evidence? The point to meet is that there would be no difficulty whatever in classifying a similar incomplete skull from any ordinary mammal or reptile.

A few words are required about the fossil forms you describe, in your peculiar phraseology, as appearing suddenly. Obviously if we have a fragmentary record (our record) the fossils will 'appear suddenly.' All the same even the fossils you choose as examples show definite evolutionary evidence. You surely cannot attach any importance to the 'sudden appearance' of insects and spiders which have no hard parts. You speak of web-spinning apparatus in the spiders. Why web-spinning? Only some spiders spin webs, though nearly all spin threads. There is no evidence that the Carboniferous spiders span webs. The early insects are not differentiated like the later ones. Zittel says the differentiation between the orders has little depth. The *Encyclopaedia Britannica* says that the Paleodiptera combine the characters of several existing orders. Zittel also points out that a Devonian form is intermediate between insects and isopoda. The zeuglodon, though probably a side branch, is definitely intermediate between whales and other mammals. Some of the earliest known tortoises had teeth, like the earliest birds. Teeth must be a frightful nuisance to the anti-evolutionist. Clearly then, even in the examples you choose, there

is definite evolutionary evidence, unless you prefer the hypothesis of the Demiurge creating practical jokes.

You also supply tables showing that some genera are very persistent. Why not? A genus which is thoroughly adapted to a simple environment, especially in the sea, is naturally persistent. There is no evolutionary principle which necessitates change in particular species and genera. Conditions sometimes change, and then the genus either evolves or dies out. But there is no reason why species occupying simple and persistent environments should change. This example of a difficulty is not a difficulty at all.

I will conclude by trying to put this geological evidence as simply as possible. I think I showed fairly clearly in the last chapter that the fossil record (our record) is fragmentary. Consequently, as a rule we get only imperfect series, such as the ammonites, or links, such as Archaeopteryx, or Tritylodon, or the brittle stars. All this fits exactly, *we do get these*. When the record is better than usual we get either continuous series, such as Micraster, or overwhelming evolutionary evidence such as we find in the land mammals. In this case we are exceptionally lucky because the better record coincides with a period of rapid evolution. The evidence as a whole is exactly what is to be expected, in a few cases, like the Equidae, distinctly better. There is no positive adverse evidence whatever. No reasonable person can expect more. It is futile to make long lists of chains or links that have not been found. If the record (our record) is fragmentary, of course they have not been found.

This assumes the fragmentary nature of the fossil record (our record). It is a natural assumption both from the nature of the case, and from the detailed evidence, a little of which I gave in the last chapter. You have given no reasons whatever for thinking the natural assumption wrong. The only point of any real importance you have brought forward is that in one case (land mammals), where there is exceptionally good evolutionary evidence, a large number of genera have actually been found. Of course a large number of genera have been found, or the evolutionary evidence would not be there.

Yours sincerely,

H. S. SHELTON.

P.S. I have given you a reference to Professor Owen's discovery which I think is good enough (H. 269).

DEAR SHELTON,

You seem to think that because you infer evolution from ignorance, I infer creation from ignorance. In fact I infer creation because of the great weight of evidence against the only alternative to creation, namely evolution. The geological record (I use the term in the sense that Darwin and all geologists use it), which has yielded millions of fossils has not yielded a single fossil essential to the proof of the evolution theory, and as I shall show in my letters to follow, in the words of Maurice Thomas (*Revue des Questions Scientifiques* (1940) p. 333) : 'The whole animal kingdom rises up against the transformist conception.' The difference between us is that I rely on the fossils that have been discovered, you rely mainly on those that have not been discovered and which you imagine exist or once existed.

In my letter (p. 107) I called attention to several of your claims to preferential treatment by the jury. Your last letter enables me to notice a further claim by you, viz. you may draw inferences from the absence of fossils but it is '*entirely illegitimate*' (Italics yours) for a creationist to do so. My inference from the absence of fossils in Pre-Cambrian rocks is that animals were not in existence when those early rocks were laid down : your inference is that animals were then abundant and much diversified, because the evolution theory requires this. You say that the transition from recognisable to unrecognisable fossils is 'a little abrupt.' A little abrupt indeed ! Hundreds of thousands of well-defined fossils, in rocks in all parts of the world, fossils representing all the phyla except the vertebrates—then suddenly a great thickness of rocks in all parts of the world, in which, in your words, not a single 'recognisable fossil' has been found. To call this change a little abrupt is in keeping with your assertion that the differences between a 'family and an allied family is very much less than the difference between Equus and Eohippus.' Having completely failed to substantiate this last statement, you not only claim to have proved it but you ask what further proof does any one want? It is *proof*, not further proof, that everyone wants, and there is only one way of furnishing proof that would convince a court of law or any sensible person and that is complete lists of the differences between cats and civets on the one hand and Eohippus and Equus on the other. You have not given these lists, but knowing that the former list is much the longer, you say (p. 112) it is of no consequence whether I call these differences 5, 50, or 500 ! Further you say

that I gave a list of these differences. But this is precisely what I refused to do. I am however prepared to do so if you will allot me 1,000 of your allowance of words in this debate that the list would entail.

It would have saved much space if you were to reply to what I said instead of to what it would be convenient to you that I should have said. You incorrectly say I raised this matter of civets and cats. It was you who did this owing to your inability to produce a series of fossils linking two families. On top of all this you affect to express surprise that you have not made the editor and me change our views. You have strengthened these by showing that no series of fossils links two families. I note that because the geological record does not give positive evidence for evolution you take comfort in the fact that it does not give *positive* evidence against evolution, i.e., because the record does not prove a negative! You affect to be unable to understand what I mean by 'fossil record' and 'types.' By 'fossil record' I mean what Darwin and all geologists mean by the term. As to types, I named ten of these of which the earliest known fossil is a fully-developed member of the group to which each belongs. You say there is no evidence that Carboniferous spiders spun webs, but there is proof that they possessed the apparatus for spinning webs.

I note that you have not accepted my offer to pull to pieces the opinions set forth in the appendix to your last letter, but you quote more opinions. I will deal with these if you allot me a further 500 words for the purpose. You do make one definite assertion, viz., the earliest known tortoises had teeth. In fact no known tortoise or turtle has teeth in the jaws: one Upper Triassic genus, Triassochelys, had some teeth, not on the jaws, but on the roof of the mouth. As to teeth being 'a frightful nuisance to the anti-evolutionist,' he is not obliged to believe that in the Tertiary period horses exchanged rooted teeth for rootless ones, that at the end of the Cretaceous period every bird lost its teeth, as did an order of reptiles at some unknown period, and that while one order of reptiles was losing its teeth another exchanged its homodont dentition for a heterodont one.

You ask: does the fact that all we know of Tritylodon is the greater part of the skull without lower jaw affect the value of its evidence? I answer 'Yes.' Practically all the skeletal differences between reptiles and mammals are in the body skeleton, limbs, and lower jaw and the bones of the inner ear, also the presence or

absence of a quadrate bone. The only known fossil of Tritylodon tells us nothing of these characters, and no other fossil is known closely resembling it that might assist us in classifying it.

I note that you have not seen Owen's paper and not even repeated a secondhand version of what he said.

In your attempt to meet the argument against evolution afforded by very long-lived genera, you say a genus which is 'thoroughly adapted to a simple environment, especially in the sea, is naturally persistent.' But surely the great bulk of marine genera fulfil this condition. So why do some remain persistent, while others, according to the evolutionist, become modified into new genera, families, orders, etc.? In any case your explanation is unsatisfactory. Arca and Leda are two genera of molluscs now living in the sea round Great Britain. The fossils show that these have persisted unchanged from the Ordovician in the case of the former and the Silurian in the case of the latter, i.e., for some 400 million years. To-day these genera occur in most parts of the world at varying depths from low water on the shore to 250 fathoms. Arca to-day occurs in such different environments as Prince Regent Inlet and the muddy waters of the Jumna in N. India about 1,000 miles from the sea. Moreover the fossils of these genera indicate that during most of the 400 million years of their existence they have had a wide distribution and so have all along been exposed to very different conditions in various parts of their range.

You declare the geological record to be very incomplete, at any rate before the Tertiary Period, but Table VI shows that of the 174 genera of molluscs having shells now living in British seas no fewer than 64, i.e., more than one-third, were existing in the Jurassic period. Yet, according to you, most of the rocks laid down in the Jurassic period have been destroyed with the fossils they contain. If two-thirds of these have been destroyed then the 64 genera of which fossils have been found, as above, represent only about one-third of the genera now living that existed in the Jurassic period; in short no British mollusc has undergone any evolution since the Jurassic period. In truth you are on the horns of a dilemma. If the geological record be very imperfect, there has been no evolution among molluscs for some 100 million years. If not very imperfect the absence of fossils intermediate between families, orders, classes, etc., is fatal to the theory.

Yours sincerely,

D. DEWAR.

4

GEOGRAPHICAL DISTRIBUTION

DEAR DEWAR,

This section on geographical distribution is best taken now because of its connection with the geological record which we have just discussed. We here find a series of facts which are of special interest in that their collection was the main life work of Alfred Russell Wallace, whose contribution to evolutionary theory was second only to that of Darwin. Indeed it was these facts that did much to convince both Darwin and Wallace that evolution had certainly occurred. Thus, though it is ancient history, it is very relevant in a discussion with one of the few competent zoologists who still remain to be convinced of the truth of this important conclusion of modern science.

There is one point which it is well to make clear from the outset. It is not all the facts of geographical distribution which are relevant. Many of them are neutral, and this applies in particular to most of the facts concerning the distribution of existing species on the continental mass. Where you have no impenetrable barriers, such as the ocean or high mountains, a species may distribute itself anywhere where climatic and other conditions are suitable, and generally speaking such facts as these are of no use in our discussion. Similarly the distribution of most species of birds and bats, to which, as they have good powers of flight, the ocean is no barrier, need not be considered. As a rule the same applies to the distribution of sea fish, which have almost unlimited powers of migration, though even here the species differences between fish on the Atlantic and Pacific coasts of America are not without evolutionary interest. Generally speaking we can put it that where migration is possible there is very little obvious evolutionary evidence, and it is only when there are barriers to migration, and have been for a considerable time (geologically speaking) that we find the evidence we need. For that reason we must concentrate our attention on islands, lakes, and other habitats where animal and vegetable life has been isolated for a considerable time.

Before doing this it is well to mention in passing how the fossils help us to explain certain facts of geographical distribution which might otherwise seem anomalous. For example, the tapirs are now confined to South America and the districts round Malaya. The camels are Asiatic species, and the nearly allied llamas are natives of South America. It might at first seem strange that these are genetically related. But the well-known fact that fossils of both families have been found in intermediate regions clears up the difficulty.

In general what I shall attempt to show is that the geographical distribution of life is in accordance with what is expected if evolution has occurred, and that, if the forms of life were specially created, this has been done in such a way as to make it appear that they have been evolved. Then, according to our agreed principles, special creation can only be regarded as an unreasonable hypothesis.

We will first consider oceanic islands which are believed either never to have been joined to the mainland, or, like New Zealand, the junction of which, if it occurred at all, was in times inconceivably remote. Australia, which has been separated from the continental mass since Mesozoic times, is nearly but not quite in this category. The higher forms of life from amphibia upwards *ex hypothesi* were evolved on the continental mass, which includes both the Old World and America, as connection at times has been made at the Behring Straits. A rise of a few hundred feet accounts for this, very little more than that required to join England to the Continent, a junction which I think you will agree has occurred in recent times. We shall expect, therefore, that the higher vertebrates will be distributed all over the continental mass, but that in the islands there will be a great dearth of them, the exceptions being such beings as birds and bats which fly, and rats and mice, and possibly dogs, which travel with man to such islands as are, or have been, inhabited.

This is exactly what occurs. The one mammal found in New Zealand was a rat. The only placentals in Australia were bats, mice and the dingo dog. Most of the islands have no indigenous mammals except bats. We need to be a little cautious about asserting the impossibility of distribution from the mainland to the islands. Drifting timber carries many forms of life and particularly eggs. Polar bears have been known to have been carried to Iceland on the ice. Eggs of some creatures (e.g. snails) have been found attached to the feet of birds. But I know no case of the

existence of vertebrates on islands which cannot reasonably be accounted for by distribution from the mainland. In this study of oceanic islands, I will particularly call your attention to the scarcity of amphibia, particularly those very common specimens the frogs and toads, the eggs of which are destroyed by sea-water, compared with lizards, the eggs of which are not so destroyed. There are, for example, no indigenous frogs in Madeira. They have since been introduced and flourish exceedingly, making night hideous with their croaking.

It is interesting also to note that very isolated island St. Helena. This island lacks even land birds (except one wader) and reptiles. On the hypothesis of special creation, it does seem strange that, with such an enormous variety of the higher forms of animal and vegetable life, none appears to have been created on the islands.

More striking even than these significant absences are the forms of life that are present. On the hypothesis of evolution we shall expect that, when islands are easily accessible from the mainland, the forms of life will be very similar on account of continual interbreeding. If there is reason to suppose that the time when such access was possible is not very remote we shall expect the differences to be slight. When there is reason to think that the connection with other bodies of land, if it occurred at all, was in times exceedingly remote, we should expect the animals and plants to evolve on their own lines and to produce special and peculiar forms. Yet, though peculiar, we shall expect them to bear some relation to those on the mainland, or at least to those existing on the mainland in past ages.

This is exactly what occurs. There is a considerable similarity in the fauna of the East Indies adjoining Malaya, including Borneo and Sumatra. But Celebes, which is surrounded by channels of deep water, is peculiar. It contains, for example, a peculiar kind of ape, a remarkable buffalo, and an extraordinary creature related to the swine family. Once again, in the chain of islands east of Java there are no considerable distances till we come to Timor, but between Bali and Lombok there is a deep water channel indicating the improbability of junction in recent geologic time. By a strange coincidence there is a striking difference in the forms of life between Bali and Lombok. In St. Helena half the insects, three-quarters of the snails and four-fifths of the flowering plants are peculiar.

The Galapagos Islands have been described frequently. Nearly all of the land birds are peculiar to the islands. Yet, though different species, they are related to the birds of South America. One or two, very widely distributed, and apparently with exceptional powers of flight, are identical. Why, if they were specially created, should there be land birds on the Galapagos but not on St. Helena, and why should they be related to those of South America rather than to those of Europe? We must not forget also that the fauna of these islands differ considerably among themselves. There are distinct species in the separate islands, but these species are more nearly related among themselves than they are to any others. How well the facts fit in with the hypothesis that these birds are the descendants of stragglers blown over from South America by storm winds at odd times during vast ages.

Everywhere in isolation peculiar forms of life are to be found, but not so peculiar that they cannot easily be accounted for by evolution from pre-existing forms. The most striking example is Australia. It is not fully known how it happened that the ordinary mammals never gained a footing in that continent. As you will probably enlarge on this lack of knowledge, I will say nothing about it till you have had a chance to speak. Whatever the reason may be, the placentals did not get a footing there, and the result has been a remarkable evolution of the marsupials. The simple marsupials found in the rocks of remote epochs have evolved and flourished exceedingly, producing vegetable feeders, flesh eaters, and even a colourable imitation of the flying squirrel. Further evidence that they have so evolved is provided by the geologic record. Tertiary formations in Australia are not common, but those that have been discovered show no remains of placental mammals, only marsupials. These marsupials are not the same as those existing to-day, but they are marsupials none the less, and belong to groups now living in Australia. As you are an expert in birds, I need not point out the peculiarities of Australian bird life. Needless to say, owing to the power of flight, species are found similar to those on the continental mass, but the great variety of birds peculiar to this area needs only to be mentioned.

The Sandwich Islands are another good example. Wallace tells us that three-quarters of the land shells belong to peculiar genera, and that one sub-family (Achatinellinae) is confined to this group of islands. Also 352 species and 99 genera of beetles are peculiar to the islands. In this case the introduction of the ancestral beetles

must have occurred a long time ago when the distribution of the nearest islands was probably very different.

Equally suggestive is the fauna of South America. This is an enormous tract of land, sometimes isolated, and sometimes as at present open to invasion from the north. In South America, as in Australia, the fossil forms are related to those now living, not identical, definitely distinct species, but of the same general type. It should be pointed out that this similarity is powerful evidence for evolution. On the hypothesis of special creation there is no reason why the present should bear this relation to the past. If the old mammals died out and a new lot were created, there is no reason why the later ones should be of the same type as the earlier ones.

Nor is it only in land animals that unusual evolution occurs in isolation. The classical example of a similar occurrence in isolated bodies of water is Lake Baikal. The fish of that lake, needless to say, are peculiar, but still more so are the crustacea. The crab and lobster type seems never to have reached this lake, but in its place, occupying the same niches in the economy of nature, is a remarkable series of Gammarids. Several hundred species are known. On the hypothesis of special creation, assuming that a special fauna is created to people an isolated lake, why should they be Gammarids? We could as easily expect types bearing no relation to species elsewhere.

I need not emphasise that plant life, like animal life, shows the results of isolation. The extraordinary variety of peculiar flora in Australia and New Zealand needs only to be mentioned. Yet, though peculiar, they belong to the same classes as the plants of the continental mass, and usually to the same orders. Another peculiarity of the flora of isolated islands is illustrated by the Azores. Not only are there many species peculiar to the islands, yet related to those of the African mainland, but the kind of species is suggestive. They are species with wind-blown seeds, and species with small seeds readily carried in the intestines of birds, and, generally speaking, species of wide distribution. There is a remarkable absence of species with large heavy fruits, the carrying of which across the ocean is much less likely. On the hypothesis of special creation we should naturally expect a proportion of this type.

This will suffice for a first letter. We can briefly sum up by saying, assuming that evolution occurs, that in isolated districts species will adapt themselves to the peculiar conditions, whether

of climate, food or enemies. We should therefore expect to find just what we do find, namely, species related to those in the neighbouring districts, but different in detail. Also, though there is no absolute rule, we should in general find, in districts isolated for a long time, greater differences in the forms of life from those on the mainland than in those isolated for a shorter time. Evolution explains all these things, and I know of no other explanation.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

Your statement on p. 140 betrays a complete misunderstanding of our 'agreed principles.' You are referring, I assume, to pages 10–13 of the introduction, which the reader should re-read.

The main difference between us is, as I have already pointed out, that my approach to the problem of creation is inductive. I do not pretend to your sources of illumination. I do not know enough about the Creator to say whether or not creation took place only on the mainland. I agree, however, with Charles Kingsley (and this is my only deviation from the inductive to the deductive method) that God would not write on the rocks a monstrous and superfluous lie. Where, for instance, I find that the rocks are eloquent in their testimony to the suddenness with which a great marine fauna appears, I do not believe that God would have written on the rocks a lie so strongly suggesting a great creation at the beginning of the Cambrian period, if these animals had evolved gradually.

But I never agreed that, where the evidence is equally easy to reconcile with two hypotheses, creation and evolution, God must be held to have suggested falsehood because one of these two hypotheses cannot be true. It is odd that a distinguished contributor to *Mind* should have been unable to distinguish between two such very different positions.

In your letter you mention no facts that are incompatible with special creation, but you cite some facts against evolution!

You believe that every species of each Order, and every Order within a Class, is derived from a common ancestor. If this were the case, the geographical distribution of animals should show clearly the locality in which each Order of a Class originated and how the species of each reached their present habitats. But I put

it to you that it is not possible to do so and this is a serious objection to the evolution theory.

The Amphibia are a small class formed of only three Orders and 20 Families. Here are a few of the difficulties you encounter if you expect the evolution theory to account for the present geographical distribution of the Class. The Coecilians (legless, worm-like, burrowing amphibia) occur in America from Mexico to Peru, Tropical Africa and the East Indies. How did they come to be thus distributed? One genus, Dermophis, is composed of 6 species, of which 5 inhabit America and 1 West Africa. Another genus, Uraeotyphlus, is made up of 3 species, 2 of which live in the Malabar Hills of South India and 1 in West Africa. Of the tailed amphibia, the genus Amblystoma has several species in N. America and 1 in Siam. Among the frogs, the family Liopelmidae is composed of 2 genera, one of which is found only in New Zealand and the other in the N.W. corner of the U.S.A. The Dentrobatidae is composed of 2 genera, one of which is confined to Madagascar and the other to S. America. Nearly all the species of the Cystignathidae live in Australia and Tasmania, but a few occur in America south of Mexico. In my view, these facts fit the theory of creation much better than they fit the evolution theory. If you disagree, please say where each of the above groups originated and how they reached their present habitats.

In my view, the facts of geographical distribution are unfavourable to the evolution theory because they show:

I and II. That some species and some genera are very stable.

III and IV. If ever a Family or an Order evolved from a pre-existing one, the process must have been so slow that the earth has not been in a habitable condition nearly long enough to allow a Protozoan to have evolved into a mammal.

I. *Evidence of the Stability of Species.*

The stability of many species is shown by the wide area over which they are spread. As an example, let me cite the wingless insect known as the spring-tail. The species Isotomurus palustris occurs in all parts of Europe (including the British Isles, Sicily and Sardinia), in Siberia, Nova Zembla, Spitzbergen, Bear Island, Greenland, Ellesmere Land, Canada, U.S.A., Mexico, Costa Rica, British West Indies, Cuba, Argentina, the Azores, Algeria and Mesopotamia. The individuals living in, say, Siberia, must have been isolated for a very long time from those living in the Argentine

and have been subjected to very different climatic conditions, yet there is no difference in their appearance. No one shown a spring-tail of this species could tell whether it lived in Cuba or Spitzbergen or any other particular locality. A very large number of species of animals of all kinds exist, of which the geographical range is great; and in many cases the range is discontinuous, e.g., that of the snake Polydontophis melanocephalus, which occurs, as far as is known, only in the Malay Peninsula and Archipelago, Comoro Islands, Madagascar and Central America.

The facts of geographical distribution show that, if new species do arise by evolution, the process is very slow. Dr. F. E. Zeuner has made a careful study of the distribution of a group of swallow-tailed butterflies living in the Malay Peninsula and Archipelago. He describes about 70 species of these, some of which are confined to one island. He believes that these are all derived from a common ancestor, and have arisen in consequence of their isolation on these islands, and, taking into consideration the times at which various parts of the area have been under the sea and re-emerged, he writes ('Systematics of the Troides and its Allies,' *Trans. Zool. Soc.* (1943), p. 174): 'One will be fairly close to the mark . . . if one accepts a period of 500,000 to one million years as the time for the evolution of a "good" species.'

Butterflies are land species. Those who have studied the geological and geographical distribution of animals have come to the conclusion that the evolution of a new marine species takes much longer than that of a land species. Thus E. Mayr writes (*Systematics and the Origin of Species* (1942), p. 223): 'Speciation in marine animals moves at a snail's pace as compared to that of terrestrial animals. The connection between the Atlantic and the Pacific oceans (at Panama or Nicaragua) was interrupted some two or three million years ago, but some of the species of fish and crustaceans are still the same on both sides of the Isthmus of Panama. . . . The palaeontology of marine animals indicates the same slow evolution as does the existence of so many bipolar species.[1] The speed of evolution should not be overrated, even in terrestrial groups. . . . Many of the insects of the mid-Tertiary amber cannot be separated specifically from living species, and even an amber fauna believed to be Cretaceous was found to be remarkably similar to living forms.'

I do not know what time-scale Mayr uses in saying the connection between the Pacific and Atlantic oceans was interrupted 2 or

[1] Species found in both the Polar Seas and nowhere else.

3 million years ago. Scott, on the strength of the mammal fossils, writes: 'In early Pliocene times the junction between the two continents (N. and S. America) was re-established and has continued to the present day.'

According to the time-scale we are using, the Pliocene period began 15 million years ago, and this would mean that the communication at Central America between the Atlantic and Pacific was cut off some 12 million years ago. The mid-Tertiary amber to which Mayr refers, on our scale, was formed about 30 million years ago.

II. *Evidence of the Stability of Genera.*

Very little work seems to have been done with a view to discovering how long it takes to change one genus into another, presumably because, if such change has actually occurred, it is so slow as to make it difficult to estimate the pace. But the data of geographical distribution show that many genera are very stable in that their geographical range is great. Thus the White-ant genus Eutermes ranges from Africa to Australia, the lizard genus Gymnodactylus occurs in South Europe, South Asia, Australia, the islands of the Pacific and Tropical America. The genus Crocodilus (crocodile) is found in Africa, South Asia, North Australia and tropical America. The genus Tapirus (tapir) occurs only in Central America and Malaya. In some cases the fossils confirm the antiquity of these wide-spread genera. Thus, fossils of Tapirus have been found in Lower Miocene deposits, proving its existence at least 30 million years ago. In the case of Crocodilus fossils have been found in the Eocene of England, showing that this genus was in existence over 50 million years ago, while doubtful remains in Upper Cretaceous rocks suggest an antiquity of about 100 million years.

III. *Evidence that casts doubt on the idea that one Family has evolved from another.*

Many of the oceanic islands have been in existence a very long time, nevertheless all the animals on them belong to a Family now living on the mainland. In other words, *no new Family has evolved on any oceanic island.* The nearest approach to a Family peculiar to such an island are the flowerpeckers of the Sandwich Islands, which are deemed to be a sub-family of the Drepanidae. Some of the 'splitters' among systematists have raised these Sandwich Islands flowerpeckers to the status of a Family, but it is improbable that

this change in nomenclature will ever be generally accepted. In any case, the fact that this group of flowerpeckers now exists only on the Sandwich Islands does not necessarily mean that it never existed on the mainland. The Sandwich Islands flowerpeckers may be descended from mainland members of the Family that found their way to the islands when the Family was living on the mainland.

As oceanic islands are isolated and, *ex hypothesi*, were originally uninhabited, they are the spots at which evolution should be most rapid, because for a time there would be little competition for food and no enemies to fear, so that variation could run riot without being subjected to the pruning-hook of natural selection. Thus the fact that no new Family seems to have evolved on any oceanic island suggests that it is not possible for one Family to become converted into a different one.

IV. *Evidence that casts doubt on the idea that one Order has evolved from another Order.*

The mammals of Australia furnish this evidence. As you have stated, they all belong to one Order—the Marsupialia. Evolutionists seek to explain this by assuming that mammals evolved on some part of the mainland far from Australia, first the marsupials, then the placental orders. After the marsupials had found their way to Australia, but before the placentals could do so, Australia became separated from the mainland. Geologists agree that Australia became separated from Asia in the Cretaceous period, i.e., about 100 million years ago ; therefore, the Australian marsupials have been separated from all other land mammals for that length of time. But, all the known fossils of marsupials, other than those found in Australia, occur in Europe and North and South America and Africa. *Not a single fossil of a marsupial has been found anywhere in Asia.*

Clearly then, if Australia derived her mammals from some other continent, that continent must have been one in the far south. As the ocean south of Australia is very deep, if Australia was ever joined to a southern continent, the severance must have taken place much more than 100 million years ago. Thus marsupials must have existed in Australia during an immense stretch of time. But—and here is the fact which I consider fatal to the evolution theory—all the Australian indigenous mammals are members of one Order. Thus an immense period of, I should say, more than 200

million years has not been long enough for the evolution of a new Order of mammals. Nor have any ruminants or bat-like or marine mammals evolved in that enormous period. If then it takes more than 200 million years for a new Order to evolve, ten times as long, or over 2,000 million years, is needed for the evolution of a new Class and more than 20,000 million for a new Phylum to have evolved. But, according to the latest views—those of Prof. Holmes —the earth has not been in existence for more than 3,000 million years, and it is open to doubt if the earth has been habitable for half this period.

This time element is *all-important*, and in considering it I have taken care not to over-state the case against evolution ; my figures are almost certainly too low.

The lowest estimate of the time taken for the evolution of a new species is 500,000 years. As the differences between two genera of a Family are at least tenfold greater than those between two species of a genus, the minimum time needed for the evolution of a genus is 500,000 × 10, or 5 million years. As the differences separating two Families of an Order are ten times as great as those that separate two genera of a Family, 50 million years are needed for the evolution of a Family, and, for similar reasons, the evolution of an Order needs 500 million, that of a Class 5,000 million, and that of a Phylum 50,000 million years. These are startling figures, but, as Mivart pointed out over 70 years ago : 'It must be borne in mind that in tracing back an animal to a remote ancestry, we pass through modifications of such rapidly increasing number and importance that a geometrical progression can alone indicate the increase of periods which such profound alterations would require for their evolution through "Natural Selection" only' (*On the Genesis of Species*, p. 138).

The gradual conversion of a Protozoan into a Mammal involves the evolution of two Phyla—a simple Metazoan, such as a jellyfish and a Vertebrate (fish)—a matter of 100,000 million years. The conversion of a fish into a mammal involves the evolution of three Classes—Amphibia, Reptilia and Mammalia—requiring 15,000 million years, thus the whole process is a matter of 115,000 million years.

I maintain, therefore, that the facts of geographical distribution are either neutral or definitely against evolution.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I have some difficulty in discovering the relevance of much of your last letter either to my introductory letter or to geographical distribution. So far as I can discover, you have made only two objections to my thesis. The first is that geographical distribution does not give evidence of evolution greater than that which can be reasonably well described as evolution within the family. In a general way this is true. We have to consider every type of evidence for what it is worth, and the greater part of the evidence from geographical distribution does not go further than this. There are exceptions but this is the rule. The other objection is that species on the islands may be only slightly altered from extinct species on the mainland. Again this is true, they *may*. If we have evidence that it is so, it must be accepted, but I think we can assert quite definitely that it is very unlikely to be the rule.

You mention other facts, not those brought forward by me, which you think unfavourable to evolution. In more than one case, I am unable to discover what the difficulty is. In particular, I find your remarks on the time needed for evolution not only irrelevant to geographical distribution but exceedingly obscure. When the habitable earth has existed for at least a thousand millions of years that does seem time enough for anything. When in the course of 80 millions of years or so our placental land mammals have arisen from a generalised early Eocene form (or forms) in which even the difference between carnivores and herbivores seems to disappear, the question of adequate time for the earlier evolution hardly seems to arise. I think you find your difficulty in the fact that at certain times, and with certain groups, evolution takes place very slowly if at all. I must therefore emphasise very strongly that there is no evolutionary necessity for a species to change. It may or may not according to circumstances. Whether it does or not is a matter for detailed investigation. But because in particular cases evolution takes place very slowly, this is no reason why it should not take place much more rapidly in other cases. I cannot see in the time scale any difficulty at all.

You also speak of discontinuous distribution and seem to find evolutionary difficulties there. Some of these, such as the camels and tapirs, I have already explained. Others may be difficulties, but they are not evolutionary difficulties. Polydontophis melanocephalus, a *species* of snake, has a very erratic distribution. As it is a species, I cannot see the evolutionary significance of this puzzle.

After admitting a certain probability to evolution within the family, you are surely not telling me that this species has been created two or three times over. This would surely be the *reductio ad absurdum* of special creation. Snakes, by the way, get distributed by drifting timber and even in commerce, but still this peculiar puzzle is wholly irrelevant.

I don't pretend to be able to solve every conundrum concerning discontinuous distribution, and it really is not necessary that I should. The example of the camels and tapirs is sufficient to show the lines on which explanation will no doubt be made out in course of time. As, however, I can find hardly anything in your letter which needs a specific reply, I will just mention a theory which has come to the fore in recent years which, if it should be definitely established, would do much to solve many of these difficulties, and particularly similarities in the forms of life in Australia, South America and South Africa. I refer to the theory of moving continents, first brought forward by Wegener, and developed by Du Toit and others, which is assessed very fairly in Holmes' recent book on *Physical Geology*. It appears that in later Carboniferous times there was an ice age in the southern hemisphere, but nothing similar in the northern, and that this ice age cannot possibly be accounted for if the continents were in their present position. Traces are found in eastern South America, South Africa, South Australia, and Southern India, and in Southern India the ice came *from the south*. It appears probable that these continents were joined together in one mass, and that some of them (particularly southern India, which belongs geologically to the southern continent) were in very different latitudes. Since then they, and also Europe and America, have slowly drifted to their present positions. When we go back to early secondary times, therefore, we have to consider not only the possibility of changes in the level of land and sea, but the different positions of the continents themselves. Incidentally, this may throw light on the existence of coal in places like Spitzbergen. Thus the connection between Australia and Asia may not have been through Malaya at all, and Madagascar may have been connected with Asia as well as with Africa. A great many puzzles are solved if this theory be accepted. There is much to be done before this theory of wandering continents can be either established or disproved, and, though I am personally inclined to regard the theory favourably, I am not contending that it is more than a theory. It can at least be said, however, with regard to the distri-

bution of forms of life which probably occurred in these early times, that no solution can be accepted as final until this matter is settled. For the present, therefore, we must exclude the earlier geographical distribution from our discussion.

All this, however, does not affect the plain evidence I gave you in my last letter for the contention that the geographical distribution of animals and plants which can be referred to Tertiary times is in accordance with the idea of evolution, and has no other rational explanation. For what it is worth, and within the limits I have stated, the facts of geographical distribution point clearly to evolution as their explanation, and no other explanation fits the facts.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

The land bridges which are alleged to have connected the mainland with islands now isolated were available for all land mammals whether specially created on the mainland or evolved on the mainland. But when I drew your attention to the fact that you have 'mentioned no facts which are incompatible with special creation' you distort what I have said and represent me as admitting that 'geographical distribution gives evidence of evolution within the family.' I said no such thing. Mere assertion is unimpressive. Instead of sweeping aside some of my arguments as 'irrelevant to geographical distribution,' you should have proved that they are irrelevant. Our readers will have noted that whenever you are unable to reply to one of my points you describe it as 'exceedingly obscure.'

I note that you emphasise very strongly that there is 'no evolutionary necessity for a species to change. It may or may not do so according to circumstances.' Please do not be so distressingly vague. What are the 'circumstances' which explain the fact that the molluscs Arca and Leda have continued to exist for 400 million years, to which I invited your attention on page 138?

I note that you have not challenged my assertion that the geographical distribution of amphibia fits the theory of creation better than that of evolution.

Wegener's theory is, of course, completely 'neutral' so far as

this controversy is concerned, and it would be interesting to know why you should suppose that it will provide any answer to the difficulties of reconciling geographical distribution with the evolution theory.

Yours sincerely,

D. DEWAR.

5

MORPHOLOGY AND CLASSIFICATION

DEAR DEWAR,

Our previous letters have cleared the issue. Among those who oppose evolution there are various grades of opinion. There are still a few who think the world has existed for only about 6,000 years, and who accept the first chapter of Genesis as verbally and literally true. You have already separated yourself from these. Although you do not accept as valid the results of experiments on radio-active substances giving an age of the order of a thousand million years for geologic time, you do admit an antiquity for this earth besides which the old estimate of 6,000–8,000 years is absurdly small. You accept in a general way the record of the rocks showing vast changes in animal and vegetable life during the geologic epochs. You are also not definitely opposed to what Mr. Arnold Lunn defines as micro-evolution, for you admit that a plausible case can be made out for evolution or differentiation within the family. Undoubtedly some of the most striking proofs of evolution take us no further than this. But I shall attempt to show that many of the main lines of evidence are equally available both within and without those limits. In this chapter and in those that follow it will be important for me to emphasise this type of evidence, and I shall be able to treat more briefly evidence of evolution within the family, the probability of which is admitted at the start.

Now let us consider some of the problems of morphology and classification. In dealing with classification, I shall try to avoid any recent developments which are based on evolution, and to use only modes approved by you, that is classification which was established before evolution was generally accepted. Let us note in the first place that all known fossil forms belong to existing phyla. There would be nothing contrary to evolution if this were not true. I know of no reason why a phylum should not become extinct. Still more important is it that all existing phyla date back at least to the Ordovician, and all but the vertebrates to the Cambrian. This is very extraordinary from the point of view of any form of special creation. Why this fundamental unity underlying the enor-

mous diversity? If there has been any form of special creation it certainly has taken place on very restricted lines. Descent with modification explains. I know of no other explanation.

I wish now to emphasise how different this is from anything in human manufacture which can possibly be regarded as an analogy as, for example, the editor's fighter-bombers. If we wish to design an aeroplane we do not use the same fundamental plan which applies to a motor-car, still less that used for a submarine. But that is exactly what occurs in nature. Fish, birds and beasts have the same fundamental vertebrate structure. One type of flying animal (the bat) and several types of aquatic animals have that more specialised mammalian structure adapted to life on land. More extraordinary still is the fact that two other phyla, mainly aquatic, which have developed hard parts, have representatives on land, and one group has conquered the air.

As you are well aware, pond snails, land snails and whelks are nearly allied. So also are the lobster and the wood louse. The scorpion, the extinct sea-scorpion and the king-crab are another group. That enormously numerous flying group—the insects—instead of having the vertebrate structure like other flying creatures, or a peculiar structure of their own, are classed as arthropods, a classification which asserts a distant similarity to the lobster and the crab. Even if we search the depths of the oceans and examine the creatures living under incredible pressures, in a darkness illumined only by their own phosphorescence, we find they are still vertebrates, molluscs and crustacea.

Facts like these (though not all of them) were noted before evolution was seriously considered. Linnaeus thought every species had been created separately. To him these similarities were unaccountable marvels. They are still marvels. The more the structure of living things is studied the more marvellous it appears. But they are not quite so unaccountable. Our clue, the hypothesis of evolution, throws some light on the mystery. These similarities do not fit the idea of units of creation. Assuming species, families or even orders to have been created separately, there is no intelligible reason why one group of flying animals (the birds) should be something like reptiles, a second (the bats) something like mice, and a third (the insects) something like crabs. These similarities are not surface resemblances, but the underlying plan on which the creatures are built. Even if we search the past to find if perchance some flying creatures had a structure specially designed for flying, we find one

more group and they were reptiles. We may express this concisely by saying that animal life bears no sign of a structure specially designed for the conditions of its existence; the main structure of the groups with different environment is the same, but there is evidence of special *adaptation*. Descent with modification explains. I know of no other explanation.

This appears to me a suitable place to remark once more that I regard the common mode of classification—varieties, species, genera, orders, etc.—merely as a scientific convenience. Flora and fauna show no such clear-cut differences as we find, for example, in the chemical elements. Even if we include the modern discovery of isotopes, these isotopes, so far as is known, are classes of things absolutely identical. With living creatures it is very difficult to say exactly what a species is; indeed, unless a species is so distinct as to be placed in a genus of its own, it is almost impossible. I believe your definition of a species is a mutually fertile group. That, in addition to being arbitrary, is defective in that there are all grades between complete fertility and complete infertility. The mule, as is well known, is infertile, but a very vigorous animal. The wild cat of the Highlands, on every other ground, would be classed as a distinct species, but Miss Frances Pitt has shown that it is completely fertile with the domestic cat. If the numerous varieties of dogs were found in fossil strata, and nothing else were known about them, they would be classed in different genera. In any case, the criterion cannot be applied to fossil forms. According to you, are lions and tigers different species? Ligers and tigons have been bred, but I am not aware whether they are fertile. The point that arises here is that conditions are exactly what would be expected on the hypothesis of evolution: namely, a great variability which makes the term species a useful, but rough and inexact, description of fact.

Classification and morphology are inter-related. We will now turn to the morphology. Similarity in morphology is called homology, of which there are all grades. Sometimes the homology is almost complete. A good example is the horse and the donkey, which are classed as different species mainly because they are not completely mutually fertile. But they are homologous, bone for bone, muscle for muscle, nerve for nerve, or at least nearly so. I make this qualification which, so far as I am aware, is unnecessary, in case you have been ingenious enough to find some obscure exception. The differences that exist are in the proportions of the

structures. As you are prepared to consider the family as a possible unit of creation, you may admit this homology as a sign of common descent. But, according to your view, the striking homology, nearly as exact, between man and the chimpanzee, means nothing at all. You would even go further and admit that the homology between the hoof of the horse and the middle toe of Eohippus probably indicates genetic relationship; but the homologies between the rabbit, the cat and the hedgehog, which are considerable, mean nothing to you. It is important to note that the argument from homologous structures, if it means anything at all, does not favour your hypothetical units of creation, but can reasonably be applied over the whole range of the vertebrates.

Numberless illustrations can be given. To mention any considerable number would be merely to write a treatise on comparative anatomy. A few well-known ones will suffice. The wing of the bird is homologous with the fore-limb of the reptile. Let us imagine that birds *were* separately created, and that for some unknown reason it was necessary that they should be vertebrates like the reptiles. The fore-limb of a walking animal needs a certain flexibility which is given by joints. The wing requires one joint only; the rest of the bones, to make an efficient wing, must be as rigid as possible. We should therefore expect the wing bones to be simple and rigid. They are rigid, but not simple. The bones of the reptilian fore-limb are there, quite recognisable, but fused together. This does not look like special creation, but it is intelligible on the assumption of descent with modification. In the extinct Archaeopteryx the wings are smaller and less efficient, the fusion of the bones is not complete, some reptilian features remain. I am not asserting that the Archaeopteryx is the direct ancestor of the modern bird. It may or may not be, I do not know. But it illustrates the argument from morphology, and shows the exceeding probability that the typical bird structure has been formed from the reptiles by descent with modification.

On this subject of morphology and classification, the 14th chapter of the *Origin of Species* is well worth reading even to-day. So is the 11th chapter of the second part of Spencer's *Principles of Biology*, and the whole of Part III on evolution. These chapters will show that the writers of the last century had reasonably adequate data. I take a few examples from Spencer. The first is similar to the fusion of the wing bones of the bird. The sacrum of the mammal, which provides the rigidity required to support the limbs, is given,

not by a single bone, but by a fusion of vertebrae. In man there are five fused vertebrae, in the ostrich a much larger number. Why, if specially created, is a rigid part formed by the fusion of vertebrae? There was in Spencer's time some doubt about the number of segments in the insect, but it was recognised that the number of 'somites' is constant. What the recognised number now is I do not know, but is it not strange that the same number of somites are required for the louse and for a stick insect a foot long? 'Why should one crustacean which has an extremely complex mouth formed of many parts consequently always have fewer legs, or conversely those with many legs have simpler mouths'? Why, indeed?

The following is from Darwin: 'What can be more different than the immensely long spiral proboscis of the sphinx-moth, the curious folded one of a bee or bug, and the great jaws of a beetle? Yet all these organs serving such widely different purposes are formed by infinitely numerous modifications of an upper lip, mandibles and two pairs of maxillae.'

It is very curious that correlations run in phyla, although there is no obvious reason why they should do so. The oxygenation of the blood is one example. All through the vertebrates the active compound is haemoglobin, and is carried in corpuscles. The actual chemical constitution of the haemoglobin may vary slightly, but one common feature is the oxygenation by the agency of the element of variable valency iron. Neither the iron nor the corpuscles are necessary. In most of the molluscs and crustaceans the compound is haemocyanin in which the element of variable valency is copper, and there are no corpuscles. Indeed, in one phylum the comparatively rare element vanadium is utilised instead of iron or copper. I am aware that, in the invertebrates, the constitution of the blood presents some difficulties, which it is possible you may wish to expound later. This does not affect the fact that, in a general way, the blood composition follows the phylum classification, and in particular in all the vertebrates the method of oxygenation is the same. On any other hypothesis but community of descent, this uniformity is very difficult to explain.

The same applies to the structure and function of the alimentary canal. In organisms so different as the man and the frog, the homology of the alimentary canal is functional as well as structural. The liver in both cases forms glycogen, the pancreas in both cases forms trypsin. The same applies to the glands. The adrenalin of

the frog is chemically identical with our own. None of these things are necessary. In the arthropoda, the structure, the functions, and the chemical compounds involved in the organs which roughly correspond are different.

I would submit that the enormous mass of evidence to be found in the homologies of the animal and vegetable kingdoms is of a kind to which it would be difficult to attach too much weight.

What is the principle underlying classification? Why are some features important and others unimportant? Before evolution was an accepted principle, zoologists and botanists had worked out a classification on empirical principles. By some sort of instinct they knew that certain resemblances such as that between the dog and the Tasmanian wolf were unimportant, and that others such as the existence of warm blood and mammary glands in the whales and in the bats were important. But why? Apart from the hypothesis of evolution no clear reason can be assigned. The basis of a sound classification is genetic relationship. Unless that is assumed, no sound basis can be found. Why, on any other grounds, is the current classification valid? Why, for example, is the pouch to hold the young found only in marsupials and not in all of those of such importance? It is a very simple adaptation which might easily have developed in different classes of animals. You will reply, of course, that the marsupial pouch is correlated with other differences. Agreed, but why should there be this correlation? I know of no answer to this question except community of descent.

We must try to make this argument from homology quite clear. Similarity in a single organ proves nothing. The eye of a cuttle-fish is strikingly similar to that of a vertebrate. Some of the extinct South American Litopterna had single hoofs like the horse. The electric ray and the electric eel are not nearly related. Similar needs sometimes give rise to similar structures in creatures widely separated by descent, though in such cases the structures are seldom morphologically identical. Such resemblances are known as analogies, and it is interesting to note that the distinction between analogies and homologies is not an invention of the evolutionists, but was formulated by that well-known nineteenth-century opponent of evolution, Professor Owen.

What gives evidence of common descent is that deep-seated fundamental homology of structure and function. When, as in the vertebrates, not only are the bony structures a series of modifications of the same fundamental plan, but the same is true of the general

character of the alimentary canal, the structure and function of the liver, the pancreas and the ductless glands, the chemical identity of many of their products, the chemical composition of the blood, the structure of the brain, the lungs and the kidneys, we are impelled to search for an explanation. These structures and functions are not necessarily implied in the nature of living things, nor are they necessitated by the physico-chemical environment. This is shown quite clearly by the fact that in the cuttle-fish and in the lobster, both fairly highly developed organisms, all these features are different. Then why do they occur in such vast multitudes of organisms? I know of no explanation but descent with modification.

These facts alone, if the fossil record had been entirely destroyed, would still show the hypothesis of evolution to be exceedingly probable. They all fit in. To make evolution the obvious explanation, only two other data are needed. One is the variability of organisms. That is obvious. For that fact we need look no further than our domestic dogs. The other is sufficient time for the changes to take place. That is the fact that Linnaeus did not know. When, instead of a few thousand years, a thousand million years is a reasonable estimate for the existence of life on this earth, the enormous changes that have taken place can readily be accounted for as the sum of many inconsiderable ones.

A little later in the discussion you will bring forward a number of difficulties, and ask me how this or that structure can be accounted for by descent with modification. I am not sure that in every case I shall be able to give a satisfactory answer. What I want to emphasise here is that they are *difficulties*: problems for future research. The main trend of the evidence is clear. The structure of animal and vegetable organisms is very much what we should expect it to be if formed by descent with modification. It is not what would be expected if species, families, or even orders, had been separately created. In the general structure of animal and vegetable life I can find no evidence for 'units of creation,' or for special creation of any kind. The general trend of the evidence is clear. I wish here to submit that this general type of evidence is of the utmost value, and that very great weight should be given to evidence of this kind, which in a detailed discussion is liable to be overlooked.

In conclusion, perhaps I may be allowed to say a word or two about the evaluation of evidence. In this vital question of evolution there is no such thing as direct evidence. Certainly the evidence

from geology, important as it is, cannot rightfully be so described. It is therefore important to point out that, of all this indirect evidence, these facts of morphology are perhaps the most significant *for both sides*. The facts are plain, and have long been known, at any rate in their main outlines. Their evolutionary explanation is simple and clear. Just as the Copernican astronomy displaced the old Ptolemaic theory mainly because it gave a clear and simple explanation in place of complicated cycles and epicycles, so evolution has displaced the older explanations of the facts of morphology (if there are any that can be so called), mainly because of its clarity and simplicity. We can dispense with your special creations in the same way as we can with the angels who were supposed to carry the planets round in their orbits. Both are superfluous. On your side, also, morphology is the only place where difficulties can be alleged which need to be taken seriously in a scientific discussion. You will no doubt expound some of them shortly. No line of evidence is all-important, but I think in morphology we find the most important, and the rightful starting place. That being so, I wish to emphasise the beautiful simplicity of the evolutionary explanation of many facts which otherwise have no explanation at all.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

None of the facts set forth in your letter are against special creation, but some are against evolution. It is to your interpretations that I demur, and to your analogies.

The designer of an aeroplane does, in fact, use an engine constructed on the same fundamental plan as that of a car. The fighter-bomber designer adapts the fundamental design of the bomber. No analogies are perfect, else they would cease to be analogies and become identities, and no analogies are more dangerous than those which argue from a human to a Divine Creator, but within these limits the analogies from human creators tell against you.

When you were invited to state why the Creator should start *de novo* and not make use of certain characteristics in certain types you replied loftily that this is a scientific discussion, but the whole basis of your last letter is, in effect, theological, and until you can explain why the Creator should not use 'the same fundamental

plan' in the creation of different types it is clear that much of your letter is not relevant to our discussion.

I am amused at the way in which you evolutionists repeat each other. Haldane made that silly remark about 'the angels who were supposed to carry the planets round in their orbits,' but neither he nor you name the astronomers, if any, who believed this. Actually, the pre-Copernican astronomers adduced facts in favour of their thesis, which apparently is more than you are able to do in support of yours. Moreover, their arguments seem to me as convincing as those whereby you defend evolution. I accept Copernican astronomy for the same reason that I accept special creation. Both theories explain far more facts than any rival theory.

You cite the similarities that run through the vertebrate phylum as proof of the descent of all the vertebrates from a common ancestor. From this it follows that, as you admit each phylum is constructed on a fundamentally different plan, the phyla are *not* descended from a common ancestor; in other words, that each of these was specially created.

You admit that all the phyla were in existence in the Ordovician period. This is equally true of the aquatic Classes. Thus, no new Phylum or aquatic Class of animals has evolved since the Ordovician period. Since the Ordovician only 5 new Classes have appeared, and, these being all land Classes, if they existed in the Ordovician period or earlier, cannot have left fossils in the known Ordovician or Cambrian rocks because these are all marine. Two of these land Classes—the insect and Amphibian Classes—appear in the earliest known land rocks—the Devonian—i.e., in the earliest possible period in which their fossils could be preserved. After that, only three new Classes appear—the reptiles, birds and mammals—all of which, like the amphibia, belong to the Vertebrate Phylum. Hence, if you believe that these Classes are the products of evolution you have to believe that the Vertebrata were unique among all the Phyla in throwing off new Classes long after all the other Phyla had lost the power to do so. It would be strange if this were so. But this is not a sufficient reason for denying it is so. And this is where the morphological evidence comes in; the morphological differences between the vertebrate classes are so great that a gradual transformation of one Class into another is, I submit, incredible.

Before demonstrating this, I must notice your statement that the basis of a sound classification is genetic relationship. This is refuted by the fact that chemists, although they classify crystals and

the chemical elements into 'families,' do not invoke the principle of evolution to account for these groups.

The present classification of animals was made by zoologists who were not evolutionists, and who when making it did not take the fossils into account; nevertheless, it has been but little modified in consequence of the inclusion in it of the thousands of fossil forms since discovered. All these (even the oldest) fit in to the original Phyla and Classes. This last fact is most unfavourable to the theory of evolution. Had this theory been true, the fossils of the earlier periods would have completely revolutionised a classification of animals made without taking into consideration extinct animals.

As animals differ from inorganic substances in that they exhibit the phenomena of variation and reproduction, you may ask: may it not be that the causes of the diversification of the animal kingdom differ from those of the diversification of inorganic things? To this my reply is, that a close examination of the morphological characters of animals gives no grounds for supposing this to be the case, because these characters show (1) that no Class can possibly have been gradually changed into another Class, nor a Phylum into another Phylum; (2) that it is highly improbable that all the members that compose a Class are descended from a common ancestor.

Evidence that no Class of Animals can have gradually changed into another Class, or one Phylum into another.

1. *The alleged gradual transformation of a reptile into a bird.*

Lunn, in his introduction (p. 20), raised the difficulty of the evolution of feathers, which you tried to evade in your first letter. I drew your attention to this and in your reply you said that you must defer the detailed discussion until the appropriate chapter. This is the appropriate chapter and I request you to describe how a reptile could possibly have gradually developed feathers and become transformed into a flying bird. I also request you to take any ordinary reptile, either quadrupedal or bipedal, or, if you prefer, a marine reptile, and describe the main stages by which the fore-leg became gradually changed into a feathered wing like that of a bird. Please describe the mode of locomotion of this reptile-bird at each main stage of its transformation. Please show also the way in which its skeleton was adapted to its changing habits. For my part, *I cannot conceive how this supposed half-reptile half-bird could possibly survive while it was losing the adaptive advantage of its reptilian*

ancestor and before it acquired the characters that adapt every bird so admirably to its mode of life.

You, as an evolutionist, believe that mammals, like birds, gradually evolved from reptiles, and as I believe that such a gradual transformation of a reptile into a mammal is utterly impossible I invite you to deal with :

2. *The gradual transformation of a reptile into a mammal.*

Such a transformation would involve, in addition to a number of physiological changes, and changes in the soft parts of the body, fundamental skeletal changes. I will here deal with only the changes involved in the lower jaw, and the ear. These are :

(1) In every reptile, past and present, each half of the lower jaw is composed of six bones, in all mammals it is made up of only one bone.

(2) In every reptile the lower jaw articulates with the skull, not directly as in all mammals, but through the intervention of a bone, known as the quadrate.

(3) In all reptiles the drum of the ear is connected with the tympanum by a single rod-like bone, called the columella ; in all mammals this connection is by a series of three bones—the stapes, malleus and incus, so-called because they are in shape respectively like a stirrup, a hammer and an anvil.

(4) In the mammalian ear there is a very complicated organ—the organ of Corti, that does not occur in the ear of any reptile. The most striking feature of this is its 10,000 rods or pillars (into which run some 20,000 nerve fibres) set in two rows on a base ; each rod in a row leans towards its opposite number in the other row, so that their swollen ends or heads meet, the convex head of one fitting into a concavity in the head of its opposite rod. Thus a tunnel composed of some 4,000 arches is formed. Sound waves cause these rods to vibrate.

I maintain that the above changes cannot possibly have been effected gradually and, in consequence, the theory that a reptile ever became gradually converted into a mammal is untenable. If you disagree, please describe, stage by stage, how these various changes can have taken place, the order in which they occurred, and how the organ of Corti can have started, and describe its gradual development into its present condition.

As all reptiles, past and present, seem to have fared or to fare quite well with their present type of lower jaw and hinge to the

skull and with their present auditory apparatus, please state what caused one kind of reptile to get rid of five bones on either side of its lower jaw, to change the type of its hinge with the skull and to exchange its reptilian auditory apparatus for the mammalian type. Please explain how this reptile, while its jaw- and ear-bones were being thus reorganised, contrived to eat and to hear. Moreover, how do you account for the fact that, whereas thousands of fossils of reptiles have been found, all of these have six bones on each side of the lower jaw and one ear bone; not a single fossil has been found of a reptile having 5, 4, 3, 2 or 1 bone on each side of the lower jaw, and all have one ear bone and none 2 or 3 ear bones; also why no living reptile displays any of these peculiarities.

3. *The alleged gradual transformation of a Land Mammal into a Whale.*

It is an article of the evolutionist creed that the Cetacea are descended from land quadrupeds. I maintain that the transformation of a land quadruped into a whale or a whale-like creature cannot have been effected gradually because for a very long period the quadruped about to become a whale must have had a hipbone too small to serve as a base on which the hind legs could articulate, but too large to permit the muscles that move the great tail of the whale to be attached to the backbone, in consequence the unfortunate animal could neither walk properly on land nor swim well in the sea. Twenty years ago Vialleton pointed out that such a creature cannot have existed and that it is an illusion to search for the fossil of an animal mid-way between a land quadruped on the one hand and a whale or a dugong on the other. Such a fossil will never be found. I have repeatedly challenged evolutionists to describe or make a sketch or a diagram of a possible animal mid-way between a land quadruped and one adapted to swim in the manner that cetaceans and sea-cows swim. So far, this challenge has not been accepted; accordingly, I extend it to you. I do not ask you to describe the actual ancestor, but a *possible* one between a present-day whale or a sea-cow, or a Zeuglodon on the one hand and a land quadruped on the other. If you accept my challenge I shall be delighted to criticise your description or sketch. The matter of locomotion is by no means the only difficulty involved in the supposed transformation. The mother whale gives birth to her young one and suckles it under water: both mother and young have to be specially adapted to this. The mother has a receptacle into which she can secrete milk; this receptacle is provided with

muscles, of which the contraction forces the milk into the mouth of the young one. She has also a cap round the nipple into which the snout of the youngster fits very tightly to prevent it absorbing sea water with the milk she gives it. The young one has its wind-pipe prolonged above the gullet to prevent any of the milk ejected from the mother's receptacle getting into its lungs.

Please bear in mind (1) that no gradual transition is possible between the young one being born and suckled on land or in the air and in being born and suckled under water; (2) the latter would be impossible before the above apparatus was fully developed; (3) therefore, *all the modifications of both mother and baby would have to be complete before the first baby whale could be successfully suckled under water.* Thus you have to account for the pre-adaptation of both mother and young for suckling the latter under water and the complementary adaptation of parent and young, i.e., the size and shape of the cup round the mother's nipple to the size and the shape of the youngster's snout, so as to keep out the sea-water. Do you seriously believe that these mutual pre-adaptations of mother and offspring were the chance results of the accumulation of fortuitous variations in adult and young?

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I am sorry if I seem to plagiarise from Haldane. I did read Lunn's discussion with Haldane at the time, though I have not seen it since, and possibly some of Haldane's remarks may be at the back of my mind, though I have forgotten the source. If either here or elsewhere I am using arguments or analogies previously used by Haldane, I wish to make due acknowledgment. I cannot give you any definite reference to the angels carrying the planets round in their courses; but if you will read Dante's *Banquet* (there is a good English translation) you will find an account of the point of view of those who accepted the mediaeval construction. It is a very beautiful construction, and the only reason for abandoning it was that it was not true. The comparison of your ideas with those of mediaeval philosophers, which were at least coherent and harmonious, is unduly complimentary to you. Your ideas of special creation, in addition to not being in accordance with the knowledge we have, jars exceedingly both from the religious and

aesthetic points of view. They fit neither science, nor orthodox Christianity, nor Genesis, nor common sense, and can merely be regarded as a regrettable eccentricity. As I mentioned before there is a sense in which special creation will explain anything, which is merely another way of saying that it explains nothing.

It is very trying to deal with a letter so much of which seems to me pointless. For example you keep on telling me that I admit things which I do not admit at all, or which I positively assert. As an example of the first you tell me I admit that the phyla were specially created. Of course I do not admit anything of the kind. Their relationship is obscure, and, as they were evolved before the date of recognisable fossils, and probably before the evolution of hard parts, palaeontological evidence is not available. But they are not so different as to be beyond the reach of reasonable speculation, although it *is* speculation. Here is an example from the *Cambridge Natural History*. (Fishes p. 31) 'However improbable it may appear at first sight it is possible to hold the view that Balanaglossus is related at the same time to vertebrates and to star-fishes and other echinoderms.' Brachiopods are a puzzle from the point of view of the phyla, and it is difficult to know where to put them. Peripatus is intermediate in structure between worms and arthropods. In its embryonic structure it simulates the worm. Certainly the relation between the phyla is obscure, but erratic forms show *possible* ways in which they may be genetically related. The worm form, for example, is a possible ancestor to several phyla.

You also say I 'admit' that all phyla were in existence in the Ordovician. Why admit? I believe I *asserted* it. That is good evolutionary evidence. Phyla do not come into existence in an erratic and unaccountable way, as might well happen if they were specially created. Why should the vertebrates succeed in 'throwing off new classes?' Surely it is obvious that the change from life in the sea to the full conquest of the land implies fundamental morphological changes. Classes are not 'thrown off'; they take hundreds of millions of years to evolve. You mention again the surface incredibility of the process, but I need not add anything to what I said in the first chapter on that aspect.

Now let us pay a little attention to your special difficulties:

1. I can't make sense of some of your remarks about classification. The fact that extinct organisms fit fairly well into the same classification as living organisms is good evolutionary evidence. If they did not it would be a serious difficulty.

2. You must state your question about the bird and the reptile a little more clearly. I have already given you a speculative theory of the origin of feathers. I have suggested the origin of flight by the analogy of the flying squirrel, different species of which, by the way, vary considerably in their powers. Of course I can't tell you the mode of locomotion at each stage, though I think it highly probable that the birds were descended from a bipedal reptile. It is well also to repeat that Archaeopteryx had *not* acquired many of 'the characters that adapt every bird so admirably to its mode of life.'

3. I have already pointed out that fossil forms have been discovered intermediate between mammals and reptiles in the structure of jaws and earbones.

4. The question of the *possibility* of the evolution of the whale from a land mammal is answered to a considerable extent by living forms. The manatee, for example, suckles *in* water but not *under* water, which suggests the mode of transition. Obviously the original whales would be comparatively small creatures, and most of the difficulties, which arise because of the abnormal size, are irrelevant. Seals have hind limbs under the skin (with of course a pelvis) and sea lions have small functional hind limbs, which do not interfere with the swimming. I note here also another of your undignified 'challenges.' This is a brief answer to your difficulties so far as you have stated them. I think there is some point about the swimming which you have not made clear. I should like to deal with it, but you must state a difficulty clearly before I can answer it.

I will conclude by repeating the most important point about classification. You do not seem to understand it, and certainly have made no attempt to answer it. What is the principle on which you classify living things? Why are some obvious differences such as size and shape unimportant? Why, for example, is a whale classified as a mammal and not as a fish, despite the surface resemblances to the latter? The point that I am putting to you is that by a process of very subtle insight the earlier biologists found a principle which they could not clearly enunciate or explain, and which indeed could not be clearly explained in terms of the knowledge of the time. When you say that the forms of life were classified *as if* they were genetically related, the principle is clear, and I do not think it can be expressed clearly in any other way.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

I am amused that you should take your views on mediaeval astronomy from a poet who makes no pretence to be writing science. I am glad that you have made so clear the contrast between your approach to ultimate problems and my own. I lack your robust confidence in your power to impose on the Deity a mode of creation which accords with your particular religious and aesthetic preference. Lacking your private sources of illumination I prefer the inductive approach to this problem. I do not handicap myself with aesthetic criteria (for the bias in favour of one fact of creation rather than several is in essence aesthetic) but go to Nature to try to discover what happened. The question at issue is whether the great groups of the animal kingdom appeared suddenly or evolved gradually. That is a strictly scientific question and those who start on their researches unhampered by *a priori* dogmas are more likely to reach the truth than those who flatly refuse to consider any evidence which conflicts with those prejudices.

I notice in your letters an increasing tendency to substitute assertion for argument, opinions for facts, and to evade discussion by loud and confident pronouncements as to the intellectual inferiority of those who disagree with you. The question whether special creation is inconsistent with science and common sense is a question which cannot be decided, as you seem to suppose, by your *ex cathedra* pronouncements. *Shelton locutus est causa finita.* I am amused that Pope Shelton should arrogate to himself the right to assert that a belief that was the traditional belief of Christendom for nearly nineteen centuries is inconsistent with 'orthodox Christianity and Genesis.'

Your refrain 'there is a sense in which special creation will explain anything' would be as impressive as it is melodious had you made the *slightest* effort to suggest a natural mechanism whereby all living things could have evolved.

You describe my challenges as 'undignified.' Why? This book arises out of a challenge to you to defend your beliefs. There is nothing undignified about issuing a challenge but there is something very undignified about evading a challenge. You have evaded the three challenges I issued in my last letter, I therefore repeat them. Before coming to them I have a few comments to make on the early part of your letter. You assert that I assert that you admit that the phyla were specially created. That is not so. I pointed out that you had made an assertion, the logical consequence of which was that all the phyla were specially created.

I had very good reasons for saying that you 'admit' that all the phyla were in existence in the Ordovician. We are arguing a case and your statement or assertion to the above effect, being very damaging to your case, is in legal parlance an admission. There is another reason; you asked my authority for saying the vertebrates existed in the Cambrian, implying that you did not admit this. In consequence, instead of basing my argument against evolution on the existence of all the phyla in the Cambrian, which you might have been inclined to contest, I used your admission by basing my argument on the existence of all the phyla in the Ordovician. Clearly some of my statements are too subtle for you.

Many thanks for your statement that Classes take 'hundreds of millions of years to evolve.' If the evolution of a Class involves hundreds of millions of years, that of a phylum involves as many thousands of millions. Now, according to Holmes (whose figures we are accepting as a basis in our discussion), 'all the evidence is in harmony with the conclusion that the earth is between 1,600 and 2,000 million years old.' But certainly all the phyla (except possibly the vertebrates) were in existence in the Cambrian period about 500 million years ago, i.e., from 1,100 to 1,500 million years after the beginning of the earth; but during a considerable portion of this period the earth was not fit to sustain life. Hence the millions of years required for the evolution of the phyla are not available.

Now for your evasions of my challenges. The first related to the gradual change of a reptile into a bird. You require me to state this a little more clearly. In fact it was quite clearly stated, but it gave you a loophole of escape of which you have failed to take advantage, for I asked you to name the stages passed through during the conversion, and this gave you the opportunity of saying you could not say, because you were not present during the supposed stages. I accordingly now modify it to: Please describe the main stages by which the fore-leg of a reptile *could* be gradually changed into a feathered wing like that of a bird. This request, while doubtless very embarrassing to you, is perfectly clear. You therefore cannot evade it by saying it is not clear, an intelligent child of twelve could understand it. While on this point I request you to name a few of 'the many characters adapting it to its mode of life' that were lacking in Archaeopteryx.

You drag into this part of the discussion the flying squirrel, although it is neither a reptile nor a bird. In so doing you ask for

trouble, since you practically compel me to issue another challenge to you, viz., to describe a series of *possible* transitional stages between the patagium of the flying squirrel and the wing of a bird. The former is a parachute, the latter an organ of locomotion. Far from being an incipient wing, the presence of a patagium is an obstacle to the development of a wing because its existence necessitates an orientation of the forelegs incompatible with flight. It is incumbent to you to show that I am wrong.

In my second challenge I asserted that a reptile cannot have been gradually converted into a mammal and, in the event of your disagreeing, I challenged you to describe, stage by stage, how the various changes involved, including the acquisition of the organ of Corti can possibly have been effected. As you have failed to do so the jury have to construe this as an admission by you that such changes did not take place gradually. You assert that Scymognathus and Cynognathus had ear bones or an ear bone, (which was it?) intermediate between the condition in reptiles and that in mammals. Please state in what way the ear bone or bones of these creatures differed from the columella of all other reptiles.

You have certainly not met my third challenge regarding the gradual conversion of a land mammal into a cetacean or a sea-cow. The question I asked was so clear that a child of fifteen could understand it, yet you say it was not clear. Apparently in your strange vocabulary the expression 'not clear to me' is a synonym for 'baffles me.' In your efforts to meet this challenge you cite seals and sea-lions as morphological intermediaries between a land mammal and a whale. In so doing you have brought trouble upon yourself, in that you compel me to issue two more challenges; further you show that you have forgotten your anatomy. As the gradual transformation of a land mammal into a seal and a seal into a whale both appear to me to be impossible, I call upon you to describe briefly the nature of these changes and say what you think caused the animal first to change its mode of locomotion on land and then in the sea, and how it contrived to exist during the period in which its legs and body were being twisted.

I note that your anxiety to show sea-lions to be intermediate morphologically between land mammals and whales has caused you to draw upon your imagination in stating that sea-lions have small functional hind limbs, which do not interfere with swimming. The truth is that the hind limbs of sea-lions are large and robust, and, far from interfering with the swimming, they

are important organs of propulsion; by their lateral motion they propel the animal through the water. As regards the origin of phyla, it is possible to imagine that the vertebrates are derived from any of the invertebrate phyla, in consequence some transformists would derive them from worms, others from echinoderms, others from arthropods. As the vertebrates are so sharply marked off from all the other phyla, one evolutionist's guess at their origin is as good or as bad as any other.

In view of statements you make in your last letter I am not surprised that you cannot make sense of my remarks on classification. You in effect say: 'Gentlemen of the jury. The earliest recognisable fossils (which were laid down some 500 million years ago) show that the animals living at that time were divided into the present phyla and classes and these groups were as sharply separated as they are to-day. They show no tendency to meet or join up. From this my opponent infers that these groups were sharply marked off at the time of their origin. This inference is a "regrettable eccentricity" on his part. The fact that the various big groups of animals were as sharply marked off from one another 500 million years ago as they are to-day is proof that they are all descended from a common ancestor. What further proof do you want? The idea of the geometricians that parallel lines never meet does not hold in evolutionary science.'

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

Your controversial methods are a matter for yourself and the editor, but I must acknowledge to finding them a little wearisome. All the same, in spite of the handicap of finding your arguments 'too subtle for me' (which I think they must be as many of them do not appear to me to make sense), I will do my best to give you such reply as is within my power.

The first point is theological. We can hardly keep theology out of the discussion as it is implied in the very idea of special creation. You appear to think that special creation 'was the traditional belief of Christendom for nearly nineteen centuries.' I do not agree, it seems to me quite modern. If you will read Genesis in its literal and grammatical sense you will not find special creation there. You will find that '*in the beginning* God created the heaven

and the earth' of which creation the rest of the chapter elaborates stages, after which 'the heavens and the earth *were finished* and all the host of them.' (Authorised Version.) Science obliges us to abandon the stages, which are certainly out of order, and the details, but the main statement may be true, and in any case is outside the scope of this discussion. The point to be noted is that up to the advent of man everything was a part of the original creation and there was no *special creation* about it. Anyone who believes Genesis to be anything more than a primitive speculation on the origin of things has to try to find a figurative interpretation. Your special creation is one of these, and I cannot see that it has any advantage over any other. In any case it is quite modern, and neither specially Christian nor traditional. So far as I am personally concerned, I am not in the least interested in trying to square science and Genesis, and here I think the modern world agrees with me ; but if anyone is interested it is just as well to point out that your special creation is a somewhat lame attempt.

Now let us get to the morphology, and I shall ignore anything more in your letter which cannot strictly be so described. In my first letter I showed (I hope clearly) that the morphological resemblances between the various types of animals fitted exceedingly well into the modern idea of evolution. This I do not understand you to dispute ; but you do think there are difficulties. No doubt there are. Some of the transformations that must have taken place are exceedingly remarkable. In the absence of direct evidence it is obviously impossible to say exactly by what stages they have taken place. In some cases it is by no means easy to point out a reasonably possible order in which the changes may have occurred, and I do not pretend that I can always do even that. This has been the stock objection to evolution since the earliest days, and it is the best objection of all, and the only one I am able to take seriously. The examples are continually changing but the type remains. Personally I always used to think the change from gills to lungs the most remarkable, and could not imagine how the change could have taken place until I discovered that certain species of living fish actually breathe both by gills and by a lung. Though these fish are probably not in the direct line of descent, they do make the change credible.

That is all the reply to your letter which seems to me to be necessary. All the same I think politeness is desirable in discussion, and this requires that I pay a little attention to what you say,

however unimportant it appears to me. The fundamental mistake I think you make (and Vialleton according to your account), is to go beyond the statement that these morphological changes are remarkable and difficult to explain, which is true, to the unprovable statement that they are impossible, which is nothing more than making dogmatic statements on the basis of ignorance. I shall therefore take one or two of your examples and say a little about their possibility. I must do so, however, with the proviso that anything I say is purely guess work, and that I am not aware that anyone has any direct knowledge of the matter.

As the first example of this guessing competition, I will take the wing of the bird. I do not see what is wrong with the analogy of the flying squirrel. In the case of the bird, needless to say, the 'patagium' must have affected the fore limb only and left the hind limb free, but I really cannot see any difficulty there. A small tree-living animal would clearly find even a primitive gliding apparatus useful both in escaping enemies and in planing to the ground in search of food. Nor can I see any difficulty in a gradual development from this stage to the full flying powers of the modern bird. I would remark in passing that I think you are entirely wrong in making a hard and fast distinction between gliding and flying. Most birds glide as well as fly, and the rigid plane such as man has made is not known in nature. All flying organs are movable, and a little extra power by the movement of the primitive wings is always possible and I think usually found. At any rate I have seen observations both of flying fish and of the flying phalanger showing that they travel longer distances than can be accounted for by gliding pure and simple.

You ask me again what characters adapting the bird to its mode of life are absent in Archaeopteryx. I thought I had answered this before. The first is the absence of pneumatic bones. The second is the absence of the fan-tail, which enables the bird to hover. The third is the lack of fusion of the wing bones, which certainly would unfavourably affect the power of flight. I may add also that the presence of teeth throws doubt on the existence of much of the modern bird's remarkable digestive apparatus.

I will conclude with a few words about the whales and the seals. If you will look at the skeleton of the seal and imagine a lengthening and strengthening of the tail and obsolescence of the limbs and pelvis, you will see that the result would give you a colourable imitation of the structure of the whale. While I do not

suppose that the whale has developed in this particular way, there is nothing impossible about it, and something of the kind would be bound to occur if the seal were to increase in size beyond very narrow limits. I therefore do not see any serious difficulty in general, and if you think there is any particular difficulty perhaps you will be good enough to say what it is.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

The editor writes : 'You and Shelton have both been very good about accepting suggestions for the removal of occasional acrimonious remarks. Shelton rebukes me for not toning down your last letter. I could not have asked you to remove the sentences he dislikes without asking him to delete from his letter the clear suggestion that no man with any pretensions to scientific knowledge or common sense (or true Christianity !) could possibly accept special creation. The conspiracy to represent the believer in special creation as a crank to be classified with flat-earthers is one of the great obstacles to a scientific discussion of species, and I am therefore glad that Shelton's remarks provided me with a chance of bringing this particular prejudice into the open. Whether special creation is inconsistent with "science and common sense" must be decided by argument and not by assertion. I think you are both feeling the strain of the repression imposed on you by your peace-loving editor, and the brisk clash of these last two letters may have helped to clear the air, and render possible a speedy return to the urbane note which has in the main, characterised this stimulating correspondence.'

In consequence of shortage of space and the editor's request for urbanity, I refrain from commenting on the theological part of your letter. I note your complete inability to meet the morphological difficulties set out in my letter (p. 163). As regards the additional ones raised in my last letter the fact that birds glide as well as fly does not help your case. A wing can be used as a patagium, but a patagium cannot be used as a wing. An aeroplane can both glide and fly ; a glider can only glide. A patagium merely retards falling ; it can neither lift nor propel ; a wing can do all these. I find it scarcely more difficult to believe that, by a purely natural process undirected by creative intelligence, a patagium evolved into

a wing than that by this process a glider became converted into an engined aeroplane.

The length of the glide of a flying fish or a flying squirrel depends mainly on the impetus given to it before its glide, and, in the case of the squirrel, the difference between the height of its take-off place and that of its landing place. I asked in what ways Archaeopteryx was not adapted to its mode of life, not how it differed from modern birds. You have not stated how a land quadruped could be gradually converted into a seal, but you ask me to imagine a lengthening and strengthening of the tail and the obsolescence of the limbs and pelvis of a seal, and say the result will give me a colourable imitation of the structure of the whale. That is not so. The seal swims by the movement from side to side of its hind legs and tail, while the whale swims by an up-and-down movement of the great tail. Therefore the seal, in order to be converted into a whale, in addition to the transformations mentioned by you, would have to twist the hinder half on the front half of its body a complete right angle so that one side of its hind-end faced upward and the other side downward!

You have certainly adduced evidence in support of your remark: 'some of the transformations that must have taken place are exceedingly remarkable.'

The morphological evidence against Evolution may be summarised:

1. The gaps between phyla, classes and orders, are so great as to preclude the evolution of any one of them into any other.

2. The distribution of morphological characters within each group is such as to preclude all the individuals of a group being derived from a common ancestor.

3. Animals exhibit hundreds of organs that cannot have originated gradually.

In my first two letters in this chapter I have dealt almost exclusively with the first of the above kinds of evidence. I have now to demonstrate . . .

The Distribution of morphological characters within each phylum class and order, is such as to preclude all the members of any of them being derived from a common ancestor.

As this evidence is necessarily technical I will here merely say that if all members of any of these groups were derived from a common ancestor it would be easy to draw up a family tree showing

the descent of every sub-group of a group from a common ancestor, in other words, to draw up a phylogenetic classification. In consequence, after the publication of Darwin's *Origin of Species* zoologists set out light-heartedly to draw up genealogical trees for every large group of animals, and many such were drawn up ; but when these were compared it was found that no two agreed, and on examination it was seen that the reason for the disagreement was each zoologist had based his tree on the set of characters he deemed most important, and the differences between the various pedigrees were not small or unimportant but fundamental. Bashford Dean exposed these differences in the cases of the Fishes (*Fishes living and Fossil* (1896), p. 282).

Others performed the same office in regard to other classes ; Vialleton in the case of Mammals (*L'Origne des Êtres Vivants* (1829), p. 180), and I, for one, did this in the case of Birds (*Difficulties of the Evolution Theory* (1931), pp. 164–175), and will here repeat what I wrote there : 'Every attempt to classify birds phylogenetically or to draw up a genealogical tree of the class has been a failure. It is submitted that the reason is, not that evolution has taken place along strange and incomprehensible lines, but that all the birds have not evolved gradually from a common ancestor ; if all are derived from some primitive stock, each family or, at any rate, each order or sub-order, sprang into existence suddenly endowed with its main characters and has since undergone comparatively little differentiation.'

The above applies equally to orders within the Classes ; thus fully a score of genealogical trees of the Primates have been drawn up. Of this order Sir Arthur Keith writes ('Man,' *Ency. Brit.*, Vol. 14, p. 761) . . . 'from the details revealed by anatomical analysis it is plain that evolution has not proceeded in an orderly manner in shaping the bodies of the higher Primates, characters are curiously scattered.'

I invite you to draw up a genealogical tree of any order or class you choose, but I assure you that your tree will not bear scrutiny because it will represent something that has never happened !

I now come to the third type of morphological evidence.

There are thousands of structures in animals that cannot have originated gradually.

Here the issue between us is that you believe that undirected forces of nature, or the purely fortuitous influence of the

environment and natural selection can create a complex organ such as the eye or a structure such as the feather, which I flatly deny.

The editor specifically mentioned the eye and the feather in his introduction. In your letter (p. 25), you evaded this difficulty. I pointed this out in my letter (p. 44), but in yours (p. 49) you said nothing about the eye, and of feathers you said you could not answer except in a speculative way. So you have still to deal with these two matters. As you exclude from your account of the evolutionary process the intrusion of supernatural and directing activity, you are reduced to placing on pure chance a burden which chance cannot bear. Do you *really* believe that a purely *fortuitous* process, the chance and unplanned selection of variations, transformed scales into feathers? I challenge you to explain (a) the mechanism by means of which scales turned into feathers, (b) the survival value of the first embryo feathers, (c) the process whereby feathers could be co-ordinated to produce flight. Please note a slow gradual evolution in a feather direction is no use. Flight is one of those 'hit or miss' phenomena which has got to be right the first time. And, to produce the necessary power and control to lift the bird from the ground even for the smallest of flights, an intricate and complex correlation of feathers, muscles, bones, etc., is necessary. Bird flight involves just as intricate a correlation as aeroplane flight. That kind of thing cannot evolve gradually.

I have already cited the organ of Corti as a structure that cannot have evolved gradually, and asked you to account for it, which you have not done. Among the hundreds of other structures I will now ask you to account for the origin and development of the spinning apparatus of the spider and the jumping apparatus of the click-insect.

Spinnerets of the spider.

Near the hind end of the abdomen of every spider there are six pairs (four pairs in the Mygalidae) of tubercules known as spinnerets. Every one of these is perforated by many (often hundreds) of minute tubes, each connected with the duct of a silk gland and opening at the tip of the spinneret which thus has somewhat the appearance of a 'rose' of a watering-can. The silk glands (of which there are about six hundred) in the garden spider, Epeira diademata, are of five different sorts, each sort secreting a different kind of silk each of which forms a different kind of thread, for, as Shipley

and MacBride write (*Zoology* (1915), p. 263), '. . . the various lines in a spider's web differ considerably one from another in accordance with the use they are put to. The circular lines are sticky and help to catch insects for the spider's food ; the radial lines are stout and form a framework for the support of the circular lines ; the threads with which the spider binds up its captured prey differ from these, and there is still another kind of thread with which it surrounds its cocoons, and each kind of line is supplied from different sets of glands.' I maintain that until both glands and spinnerets had attained a certain degree of complexity they would be useless. If you think these evolved gradually please describe what you imagine to be their mode of origin and the stages by which they obtained their present complexity, and of what use, if any, they were before they secreted silk.

The Jumping apparatus of the Click Beetle, Agriotes.

When an Agriotes is frightened it drops to the ground. If it falls on its feet it runs for cover, but if it falls on its back it instantly draws in legs and antennae and remains motionless as if dead. Then suddenly it jumps about 3 inches into the air, if it falls on its back it repeats the above performance until it lands on its feet. The jumping apparatus is a beautiful peg and socket arrangement. The peg projects from the hind edge of the lower part of the first body segment (prosternum). The socket is in the corresponding part of the second segment (mesosternum). The peg has a slide on each side—a smooth, highly polished surface ; it also has a groove round it a little behind its point. The socket has on the inner wall a pair of slides corresponding to those on the peg, and a ridge corresponding to the groove of the peg. The socket is rather larger than the peg so that the fit is not tight. When the insect is about to jump the peg is pulled out of the socket by two muscles and this stretches a spring that connects peg and socket ; but even when the muscles relax the peg cannot get back into the socket because the ridge of the latter is inserted in the groove of the peg, acting as a stop or a catch. The beetle, however, releases the peg by a violent twitch of the body, then the spring pulls the peg into the socket with such force that the shock of the impact not only jerks the insect into the air but makes a loud click from which the beetle derives its name.

Not only would this jumping apparatus be entirely ineffective until completely developed, but, although useful, it is not indis-

pensable, as the insect when on its back is able to turn over, but with difficulty, by means of its claws and by moving its legs. Occasionally it does turn over in this way. Cuénot put one on its back 115 times and it righted itself 100 times by jumping and 15 by means of its wings and claws.

The fact that this jumping apparatus is, so to speak, a luxury, and its possession is not a matter of life or death, in my opinion, shows that it is not a product of gradual evolution, and its ingenuity almost compels the belief that it is the work of a Designer. If you disagree please say how you imagine it started and describe the stages by which it has reached its present condition. In this connection we must bear in mind that, speaking generally, the animals having a very complicated apparatus do not seem to be more successful than the members of the same family that lack it.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I reciprocate the wishes of the editor (and I presume also your wish) to conduct this discussion without unnecessary acrimony. All the same I must protest that I said nothing about the flat earth, and in general, cannot accept the editor's interpretation of the passage to which he refers. If I might be allowed to make a suggestion, it is that you *see* things differently from the way the majority at the present day see them, and it is not wise to get annoyed if at times you are not understood. I remember some years ago taking part in a philosophical discussion with Dr. Schiller, Mr. Alfred Sidgwick and others, in the pages of *Mind*, and Mr. Sidgwick remarked that he was not surprised that controversialists often failed to understand each other, indeed he thought it surprising that they so often succeeded in doing so. He was good enough to remark that I was unusually successful in understanding him ; but I fear you would not be able to pay me the same compliment. I should also like to say that I often fail to see the slightest connection between my statements and arguments and your account of them. That is for the same reason. As an example note the following passage : 'As you exclude from your account of the evolutionary process the intrusion of supernatural and directing activity.' I thought I had carefully explained in the first chapter that I left that point entirely open.

I have very little more to say about these morphological difficulties. Let us take a few seriatim :

1. *Whales.* You mention that the tail of the whale moves in the vertical plane whereas that of the seal moves in the horizontal plane. I see no difficulty in this additional evolutionary change, still less in its taking place gradually. If there is a mechanical difficulty in its taking place when the pelvis is of considerable size, the obvious solution is that it took place after the pelvis was reduced to a smaller size. The use of this adaptation is obvious. It facilitates deep diving and quick return to the surface. It also enables the tail to be used as a weapon of offence. Incidentally is it not powerful evolutionary evidence that the whale has a pelvis at all ?

2. *Birds, Feathers and Flight.* In my first letter, in answer to the editor, I gave a speculative guess about the origin of feathers, suggesting how they were useful even in rudimentary stages. Also, about the eye, I remarked on the many grades in living animals between a primitive sensitiveness to light and the human eye. You are pleased to call that an evasion. The reader must judge. If it is an evasion I shall continue to evade, as I have no more to say.

With regard to flight, I disagree with you entirely, especially about the flying fish. Both from personal observation and accounts by others (F. T. Bullen who had unusual opportunities for observation is emphatic about this[1]) I am convinced that they *fly* not glide. There are, of course, different powers in different species. In spite of the Cambridge Natural History, which agrees with you, I regard both the distance they travel and the time they remain in the air as too great to be accounted for by gliding. I have no personal experience of other animals with restricted power of flight, but take the liberty of disagreeing with you entirely on the question of fact. It seems to me absurd to say that an animal like the flying phalanger with a movable incipient wing never moves it. How do you know ? This seems to me a definite point of disagreement. What you call gliding or parachuting, which is not the same thing, I call incipient flight, and I regard the difference as merely one of degree not of kind.

3. You make three general statements marked 1, 2, and 3. I cannot deal with general statements except by a direct contradiction. They do not appear to me to be true. Nor can I now set

[1] See Chapter 7 of the *Cruise of the Cachelot.*

forth a new classification of animals in general or of birds in particular.

4. *Spiders.* I think if you would start with the simplest known forms instead of the most complicated it would be easier to guess some sort of answer. I believe that some spiders use the threads only for covering a bunch of eggs, and do not possess the exceedingly complicated apparatus found in the garden spider. To give even a plausible guess of the origin of the spinnerets requires much more knowledge of spiders than I possess.

5. *Beetles.* I don't know enough about beetles to give even a guess how this particular organ arose by a gradual process, though it does seem to me on general principles that many gradations are possible in *any* jumping organ. With regard to the utility of the organ, it seems to me fairly obvious that, while ordinary wriggling will suffice to put the insect on its feet, the jumping would be a very valuable device for escaping from enemies.

Now let us try to get some sort of understanding of the difference between us. We are agreed that the adaptation of animals are marvellous. We are agreed that you are scoring a valid point in pointing out that there is difficulty in some cases in understanding how they were of advantage in their incipient stages. In the absence of direct evidence we do not know the stages by which they have arisen, and can only guess. In some cases the examination of other living creatures removes this difficulty by showing possible ways in which they could have arisen. In the case of flight, for example, I do not think there is any difficulty left. But even then we cannot be certain that the organ was evolved in that way. I have made a few guesses, for what they are worth, but do not lay stress on them. Where we differ is in the inferences. To my mind, if there are difficulties of classification (and there are) the only remedy is further research. Where there are difficulties in understanding how an organ can arise by a gradual process, the only remedy I can suggest is further study both of the organism and of allied organisms. There is plenty to be done. We are only at the beginning of our knowledge of natural history. So far as I am concerned, I do not think I have done too badly in this guessing competition; but it *is* a guessing competition. When, however, you say 'animals exhibit hundreds of organs which cannot have originated gradually,' I must part company. That seems to me to be dogmatising on the basis of ignorance. The difference between

us is, that I acknowledge my ignorance and you do not. The evidence for evolution is so strong that we can be confident that solutions will be found.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

I was under the impression that you were defending the thesis that all living forms can be accounted for by a natural process of evolution. If you regard the 'intrusion of supernatural and directing activity' as an open question, you must be prepared to concede the possibility that natural forces and processes are inadequate to explain the evolutionary process. The point is important and I hope you will clarify your position. Scientists are often in a position in which they accept a particular phenomenon but cannot explain it. The peculiarity of your position is that you are not only unable to prove how evolution occurred, but you cannot even advance a plausible hypothesis as to how it *could* have occurred. You evade every clear challenge by taking refuge in vagueness and generalities. The fact is that an incipient feather, the first signs, shall we say, of fluff on the scaly leg of a future bird could have no survival value whatever, and that it is impossible to suggest any purely natural explanation of how feathers arose or how the hit-or-miss phenomenon of flight originated.

Your favourite device when challenged to produce evidence is to appeal to the evidence which you allege has disappeared ('missing links') or to the evidence which the future is to provide. 'Keep your seats ladies and gentlemen of the jury. The witnesses whom I propose to subpoena for the defence will be brought before you in the next century or later !'

Now a scientist whose predictions are verified is naturally more impressive than one whose predictions are not. When Mendeléef propounded his periodic law, he pointed out that, if his theory were true, there must exist a number of unknown chemical elements of each of which he was able to give approximately the atomic weight. Every one of these has since been discovered. The early Darwinians predicted the discovery of fossils of pro-Aves, pro-Cetacea, pro-Chiroptera, etc. Not one of which has been discovered. More than 20 years ago Vialleton asserted that it was futile to seek for a fossil mid-way between that of a land quadruped and a

whale or a sirenian, because half-way forms could not possibly exist and propagate themselves in competition with other animals. Vialleton staked his reputation on a statement that would be upset by the discovery of any of the scores of intermediate forms that must have lived for millions of years if the Darwinian theory be true. Please note that these half-land half-marine intermediaries would live near the coast, precisely in places where most of the fossil-bearing rocks were laid down. More than a score of years have passed since Vialleton made this prediction, which, unlike those of evolutionists, has so far been fulfilled.

You ask: 'is it not powerful evolutionary evidence that the whale has a pelvis at all?' The answer is: 'Certainly not. No whale has a pelvis. The primordium which gives rise to the pelvis in most vertebrates gives origin in the whales to the two bones which stiffen the genital orifice.'

I challenged you to describe a series of possible transitional stages between the patagium of a flying squirrel and the wing of a bat; you have not accepted this challenge. At the same time I asserted 'the presence of a patagium presents an obstacle to the development of a wing, because its existence necessitates an orientation of the fore-legs incompatible with flight. I called on you to show that I am wrong. By way of reply you say that it seems to you absurd to say that an animal like the flying phalanger with a movable incipient wing never moves it. Now, the patagium of the flying phalanger is not an incipient wing, it remains rigid when the animal is moving in the air, and is folded immediately the animal alights. The patagium cannot be used as a wing, nor could it possibly be *gradually* changed into a bat's wing. You say that what I call gliding or parachuting, which is not the same thing, you call incipient flight, you regard the difference as merely one of degree. If you look up 'Parachute' in the *Oxford Dictionary*, you will find it described as 'any contrivance . . . serving to check a fall though the air, or to support something in the air, e.g., the expansible fold of skin or patagium of the flying squirrel.' The difference between a wing and a patagium is as fundamental as the difference between chalk and cheese.

I have crossed the Indian Ocean fourteen times and have spent hours watching flying-fishes in the air, and have never detected any flapping of the pectoral fins.

You say 'the evidence for evolution is so strong that we can be confident that the solutions (of all problems it presents) will be

found.' May I remind you that so far you have not produced an iota of evidence of evolution as distinguished from mere differentiation which many of those who reject evolution deem possible and believe to have occurred.

Yours sincerely,

D. DEWAR.

6

EXPERIMENTAL EVIDENCE

DEAR SHELTON,

Experimental evidence is very unfavourable to the theory of evolution. Owing to Mendel's discoveries we know that variation results from the re-combination of genes (hereditary units). We also know that if two individuals have different hereditary units these genes do not fuse into a new gene in the offspring any more than do two chemical atoms when joined fuse into a new atom. As Heribert Nilsson puts it (*Hereditas* (1935) p. 231) : 'On what does heredity depend ? It depends on the transmission of a certain heredity unit, a certain gene, to the offspring. On what does variation depend ? It depends on the regrouping of the different genes of the father and mother. . . . Variation is caused by the re-combination of the genes, not by their change. Variation is therefore restricted by the combination possibilities of the genes. And these are limited by the crossing possibilities. Then again, since individuals belonging to different species of plant or animal cannot even be paired, much less produce offspring, the combination of variations is confined to the species. Variants are formed, out-crossed and arise anew in a kaleidoscopic sequence within the species. *But the species remains the same sphere of variation.* The various species will remain like circles that do not intersect. *Species are constant.*' (The italics are his.)

Geneticists now realise that new species and new organs or structures can only arise by a mutation. Now a mutation in a gene can, so far as I can see, arise in three ways : (1) by the loss or inhibition of, or damage to a gene, (2) by the change of a gene into a different kind of gene, (3) by the origin of an entirely new gene out of nothing or, if you prefer, out of the blue. Clearly (3) would be a miracle, and so would (2) if the rearrangement of the molecules that make up a gene (which is far too small to be seen under the highest-powered microscope) were such as to produce *a new gene having the power to originate a new structure favourable to the animal of which it formed part.* Thus the only mutations available to cause evolution are those resulting from the *loss or inhibition of, or*

damage to, a gene. Breeding experiments indicate that these are the only kind of mutations that occur under domestication or in the laboratory. In other words all the breeds and mutants that have appeared are defective in some respect, although many may be useful to man. The chances of any of them surviving in nature are small. Nor is this all : *breeding operations have not resulted in the production of any new organ or type of animal*, and there is no sign of the appearance of any new kind of animal. In the case of domestic animals, after centuries of breeding sheep remain sheep, pigeons, pigeons, dogs, dogs, etc. Many of the breeds are freaks resulting from gland unbalance, such as dachshunds, fantail pigeons, etc.

The experiments of scientific breeders or geneticists tell the same story.

The animal on which geneticists have done most work is the little fruit fly Drosophila melanogaster, of which some 25 million individuals have been bred, representing nearly 1,000 generations in which about 1,000 mutations have been recorded. But these mutations are almost all clearly what may be called *loss mutations*, all are defective in some way, thus over 100 mutations of wings have been recorded, in all of which the wings are defective or reduced to stumps or absent. This is equally true of all other animals experimented on. Le Dantec compares the productions of geneticists, as the result of 35 years work, to the metamorphosis of a man at a circus, having 35 waistcoats, who, after he has removed them all, remains a man. It is for this reason that Heribert Nilsson (who is a botanical geneticist) writes (*op. cit.* p. 236, italics his) : '*The theory of evolution has not been verified by experimental investigations of the origin of species.*'

Common sense suggests that a new organ or a new kind of animal cannot result from the accumulation of losses. And so far as I am aware, no new organ or structure has been produced as the result of breeding operations. If I am wrong, you will doubtless name some new structures and state the circumstances under which these have been produced.

What makes the experimental evidence so unfavourable to the evolution theory is that *no mechanism has been discovered capable of originating any new structure or organ.* We know that the genes are arranged in series along the chromosomes, and the combined length of all the chromosomes of an animal cell is about 1/250th of an inch, and it appears to be about the same length in the case of every animal from amoeba to man. If then an amoeba-like

creature evolved into a man, as Bateson remarked over 40 years ago, man would be a simplified amoeba! As Lunn has stated in his introduction it is up to you to point out a *vera causa* capable of gradually converting an amoeba-like creature into a man.

Perhaps unwittingly, you have testified to the extent to which the experimental evidence afforded by animals is unfavourable to the evolution theory by adopting the desperate expedient of appealing in your first letter to experiments on plants as evidence for evolution and you seem to think that because some freak plants have been bred, which, on account of the duplication of their chromosomes, are infertile when crossed with the parent, you have produced some experimental evidence in favour of evolution. That being so, doubtless, in your next letter you will tell us all about it and above all show us how it helps the theory in the case of animals which differ from plants in that polyploidy is practically unknown in the higher animals and very uncommon in the lower ones.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

Your letter, which purports to be about experimental evidence, is mainly concerned with the theorising of Nilsson and others. I shall therefore begin by saying a little about the experimental evidence, and afterwards pay some attention to your letter.

Biological experiments, so far as they are relevant, fit into the general scheme of evolution very well. The only relevant aspect seems to me to be to discover whether organisms vary sufficiently to render the changes implied by evolution credible. Experiment can only answer this question to a limited extent, as it is immediately obvious that the time during which anything of the kind has taken place is infinitesimal compared with the time in which the evolutionary changes have occurred. The change from Eohippus to Equus, which is an instance of comparatively rapid evolution in nature, has taken about 60 million years. This allows at least 10 million generations, and probably a great many more. You mention 1,000 generations in the case of the Drosophila experiments. Assuming dogs to have been domesticated for 20,000 years, this might allow 10,000 generations. Obviously this is an infinitesimal number compared with that available for the natural process. If anyone fails to appreciate the very considerable change

that can be produced in a short time, the obvious answer can be given in the four simple words : visit a dog show. If the variations you can see there can be produced in 10,000 generations, what is possible in 10,000,000 generations ?

In the ordinary way I should regard this paragraph as sufficient, and the question of experimental evidence as definitely in favour of evolution. The reason for continuing this letter, and any subsequent discussion that may be needed, is that you represent a small class of people who decline to make what appear to me to be plain inferences from obvious facts. Instead of that, you, and those who agree with you, make a number of complicated and factious objections, and I must therefore devote some space to dealing with them.

The first of these objections is the contention that these inhabitants of the dog show are freaks, unhealthy, and unfitted to survive in nature. To some extent this is true, though its relevance is doubtful. We have substituted artificial selection for natural selection. But it is by no means always true. Dogs have been known to run wild and to flourish. So to a greater extent have horses, which are considerably changed from the wild ancestors so graphically portrayed in later Palaeolithic drawings. But I can give you a better example than either of these, which I have found in Prof. W. B. Scott's excellent little book on evolution. Somewhere about A.D. 1200, a few rabbits were let loose on the sandy island of Porto Santo near Madeira. The result has been what every anatomist would describe as a new species. The colour is changed. The weight is about half that of the normal rabbit. The habits have changed and the species has become nocturnal. Whether they are a new physiological species is doubtful—probably not—but the attempt to make them interbreed with the ordinary rabbit failed. What is certain is that, if their origin were unknown, they would certainly be regarded as a distinct species. In the course of a few hundred years, in adaptation to an unusual environment, a new anatomical species has been evolved under natural conditions.

The next and most important objection, about which much has been heard from anti-evolutionists in the past, is that these dogs, although their anatomical differences are so great that, if they had been found as fossils, they would certainly be classed in different genera, do not show the formation of a new *physiological* species. They can still interbreed. Huxley admitted that the case for evolution would be stronger if a new physiological species could be

formed. That is the reason for my emphasis in the first chapter of the fact that this had now been done in plants. *This particular objection can no longer be made.* I do not myself think this fact of any great importance, but it does dispose of a factious objection.

There still remains a modified form of the same objection. This method of forming new species in one step does not apply to animals, because, even when they are hermaphrodite like the earthworm, they are not self-fertilising. Such a process would require the improbable contingency of the same variation occurring simultaneously and in the same place in at least one male and one female. Nor do I think it to be the normal method of evolution in plants. We have to search for a more gradual process. This has been found in the experiments on fruit flies, which have often produced forms with reduced mutual fertility. Recently this research has been carried a step further. If you will refer to *Nature* (3rd June, 1939) you will find that two different varieties of Drosophila pseudo-obscura have been bred which when crossed produce only sterile male hybrids. This is a degree of mutual infertility similar to that of the horse and the ass. Thus even in animals the formation of a new physiological species has been achieved.

That is sufficient for the present about experimental evidence. Now a few words are necessary about Nilsson and his peculiar theory of genes. It is worse theorising than usual, and that is saying something. First of all it is well to realise that, while the chromosomes are observed objects, the genes are theoretical abstractions. All we know is that a change in a certain part of the chromosome produces a corresponding change in the structure of the animal. We hypostatise this localisation by calling the local centres genes, and this conceals our ignorance, and enables us to co-ordinate the facts to a certain extent. But it is quite illegitimate to go beyond this and dogmatise about how a mutation can occur in a gene. In the first place mutation means (or should mean) what occurs in the animal, not what is supposed to occur in the gene. With regard to Nilsson's remarks about 'as far as I can see,' the obvious comment is that he can't see anything. To damage or destroy a gene are meaningless expressions, because we don't know what genes are. Obviously also if you destroy the reproductive mechanism the cell will not reproduce. The expression 'origin of a new gene out of nothing' is nonsensical for the same reason. It would be difficult to find a better example of clotted nonsense.

Let me try to state very simply what is known on this matter. The structure of the chromosomes, in some unknown way, partially (for we do not know whether or no it is the only factor) determines the structure of the animal. In Schrodinger's phrase they form a sort of script. If you bombard these with X-rays, or ultra-violet rays, certain changes take place, and the animal shows unaccountable variations. The 'script' of these variations is often found to be localised in parts of the chromosomes. That localisation is called genes, but the concept should be used with caution, as most certainly the chromosomes as a whole are a unit. What changes, chemical or other, take place in the 'genes,' and how and why these changes affect the development of the animal, is entirely unknown. If you are interested to learn what *might* happen, considered from the physico-chemical point of view, I can recommend Schrodinger's recent work *What is Life*. This also is theorising, but at least it is theorising on the basis of a sound knowledge of physical chemistry instead of on the basis of pure ignorance. The idea is that the changes in the 'genes' are chemical, and are subject to quantum laws. It is a good idea, and does to some extent explain, but of course it is still very theoretical. At any rate it is enormously better than this destroying genes or making them out of nothing.

The moral of all this is that we are supposed to be discussing experimental evidence, which is exactly what is required by those who accept evolution. I suggest therefore that you and other anti-evolutionists attend to the experiments and leave on one side wild and foolish theorising.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

You have overlooked three very important points, viz., (1) the human breeder can and does effect changes in animals far more speedily than they can be effected under natural conditions, probably more than 100 times more quickly, because, *ex hypothesi* all but favourable variations that occur in nature are soon wiped out, whereas the human breeder can select any variation he fancies, irrespective of its being advantageous or otherwise to the animal, (2) the unnatural conditions under which domestic animals live are likely to induce variations that would not occur in nature. In fact the breeder often subjects the subjects of his experiments

to conditions impossible in nature, such as subjection to X-rays. It has been shown that in the case of the fly Drosophila, upon which so many experiments have been performed, by exposing it to X-rays the rate at which mutations appear is increased 150 times, and in the plant Crepis, 600 times. (3) In nature the odds are immensely in favour of a new variation being swamped by its possessor mating with individuals that do not exhibit this variation. The breeder, on the other hand, when he wants to perpetuate a variation, segregates the individual in which it appears and either crosses it with another individual that has varied in the same way, or back-crosses it with the parent and so perpetuates the desired variation. Thus, it seems an underestimate to say that the human breeder works more than a hundred times as rapidly as nature, and your ten thousand successive generations of dogs, as regards capacity to change, are equivalent to about a million in a state of nature. Therefore the fact that breeders have not bred anything approaching a new species of dog, is most unfavourable to the evolution theory.

I am surprised that you cite as evidence for evolution the Porto Santo rabbits, because I was under the impression that it is now generally realised that, as we do not know what breed of rabbit was let loose on that island, we cannot know what, if any, change, this race of rabbit has undergone on the island. It may well have been a small race. This, I presume, is the reason why no mention of the Porto Santo rabbits is made in any recent book on the subject, such as Robson and Richards *The Variation of Animals in Nature*, (1936).

I note that you have not named any new structure as resulting from breeding operations, and that you have not suggested any mechanism whereby the genes that control the development of an amoeba can have become so transformed, as to have produced, men, birds and reptiles instead of amoebas.

As you admit that the phenomena of polyploidy in plants afford little, if any, help to the evolution theory, it is not necessary for me to say any more on the matter, but our readers may be interested to hear that if tomatoes be cut down and allowed to regenerate about two per cent will regenerate a polyploid branch.

I am sure that Heribert Nilsson will be enchanted when he reads the enconiums you have lavished upon him. If you have any to spare perhaps you would like to confer a few on another geneticist, (whose work on the gipsy moth is known all over the world), Richard Goldschmidt, for the following statement (italics

his) : '*Subspecies are actually, therefore, neither incipient species nor models for the origin of species. They are more or less diversified blind alleys within the species. The decisive step in evolution, the first step toward macroevolution, the step from one species to another, requires another evolutionary method than that of sheer accumulation of micromutations.*' (*Material Basis of Evolution* (1940), p. 183.)

Although you have not dealt with all my objections, you have done so with one I did not raise, because, although it is an objection, it is one to which I do not attach much importance, viz., all the breeds of animals produced by breeders are fertile *inter se* and when crossed with the parent form. Why I deem this objection of minor importance is that all organs, including the sex organs, vary and no two individuals are alike (cf human finger-prints). I believe Paley to be right when he laid stress on the variety of the organic world and thought this might induce us to believe that '*variety* itself, distinct from every other reason, was a motive in the mind of the Creator or with the agents of His will' (*Natural Theology*, p. 170). This being so I see no reason why in any created form successive variations of the sex organs might not result in some individuals becoming unwilling or unable to cross with others. Moreover, chromosome inversions or translocations might well effect changes of the above kind. It may be that such occur in nature, but probably when this happens the viability of the individual in question is affected. This seems to have been the case with Drosophila pseudo-obscura, which you mention. I have not seen the issue of *Nature* to which you refer, but I think that you have misread it and that the races were not bred in the laboratory, but exist in nature. There are two races A and B, of which the range to some extent overlaps. When these are crossed the male but not the female offspring is sterile. In outward appearances the races are indistinguishable.

If we define a species as an interbreeding community we may say that no new animal species has been bred experimentally. As most species do not interbreed in nature the above definition is a convenient one, although it makes the species a much smaller group than that of which Linnaeus said : 'Every species was created in the beginning by the Infinite Being.' We may take it that all the individuals past and present that compose a species in the modern restricted sense are the descendants of a single pair ; but from this it does not follow that all the descendants of a single pair are for all time fertile *inter se*, or would be if crossed with the

parent form. It may well be that groups of what appear to be closely-allied species are derived from a common ancestor, but all the available evidence, experimental, taxonomic, geographical and geological, indicates that the extent of the diversification of the descendants of a single pair is very restricted, and that, if new species in the restricted sense now given to the term, have arisen in nature the process of species-formation is a very slow one, so slow as to make the transformist theory impossible, because life has not existed or the earth nearly long enough to allow of the gradual evolution of a vertebrate from a protozoan. If the origin of a new species be a very slow process that of a new chemical compound is the very reverse; it takes place with incredible rapidity. If you half fill a test tube with the colourless liquid silver nitrate, and pour into this some colourless hydrochloric acid, before you can say 'knife,' the whole of the silver in the test tube is lying at the bottom as the white powder, silver chloride. In less than a second every molecule of silver nitrate has become converted into a molecule of silver chloride. Now it is a postulate of the evolution theory that some inorganic compound was converted into a new substance called protoplasm, which is the physical basis of life. The change, if it took place as postulated by the evolution theory, was a chemical one, and so must have been sudden, because it is a law of chemistry, that when the right molecules come into contact under certain conditions a definite chemical change *invariably* takes place. Now we know all the chemical elements of which protoplasm is composed, viz., the gases Oxygen, Hydrogen, Nitrogen and the solid, Carbon. T. H. Huxley wrote ('The Physical Basis of Life' *Fortnight. Rev.* (1869), p. 129): 'The existence of the matter of life depends on the pre-existence of certain compounds, namely, carbonic acid, water and ammonia. Withdraw any one of these three and all vital phenomena come to an end. They are related to the protoplasm of the plant as the protoplasm of the plant is to that of the animal. Carbon, hydrogen, nitrogen, oxygen are all lifeless bodies. Of these carbon and oxygen unite in certain proportions and under certain conditions to give rise to carbonic acid; hydrogen and oxygen produce water; nitrogen and hydrogen give rise to ammonia. These new compounds, like the elementary bodies of which they are composed, are lifeless. But when they are brought together under certain conditions they give rise to the still more complex body, protoplasm; and this protoplasm exhibits the phenomena of life.

When the hydrogen and oxygen are mixed in certain proportions and an electric spark is passed through them they disappear, and a quantity of water, equal in weight to the sum of their weights, appears in their place. There is not the slightest parity between the passive and active powers of the water and those of the oxygen and hydrogen which have given rise to it . . . What justification is there, then, for the assumption of the existence in the living matter of a something which has no representative or correlative in the not-living matter which gave rise to it?'

This seemed conclusive and it was thought that living matter would soon be produced by experiment in the laboratory. Haeckel went so far as to foretell the production of protoplasm for commercial purposes! Bear in mind that the laws of chemistry are such that, whenever the right elements are brought together under given conditions, a definite chemical compound—always the same one—is invariably produced. But all experiments to produce protoplasm from the right mixture of its component elements have utterly failed. So much so, that, although evolutionists believe that life arose in the sea, if one were to give a chemist a pool of sea-water surrounded by any kind of rock or earth he required, and ask him to produce protoplasm he would laugh at the notion. Nor is this all, numerous attempts have been made to manufacture protoplasm out of dead organic matter, i.e., out of the most complicated carbon compounds known, but all have failed. Yet evolutionists believe that natural forces in the past did with *inorganic* matter, what modern chemists, with all their apparatus, knowledge, chemicals, X- and other rays, have failed to do even with *organic* compounds. Thus, *so far as it is possible to prove a negative, experimental evidence proves that the evolution theory is not true.* Nor is this all. It is almost universally held that living matter to-day is never formed from non-living matter. And the evolutionists hold that there is no evidence that this happened more than once in the past. As we have seen, a chemical compound is invariably formed when the elements that compose it are brought together under proper conditions. Therefore evolutionists have to believe that during the hundreds of millions of years that the earth has been habitable, during all the climatic changes that have taken place *only once* did the proper conditions for the formation of protoplasm come into existence, and that no chemist or other experimenter has been able to repeat such conditions. Nor is this the only difficulty the evolutionist has to overcome. If the first living protoplasm

did arise as the result of favourable chemical conditions think of the difficulties this first living matter would have to overcome. It would have to feed and reproduce itself in a world entirely mineral and without a trace of organic matter, devoid of an ounce of 'soil' in the gardner's sense ; the land hard mineral rock, or barren sand, or bare mud, devoid of bacteria or other micro-organisms, the water holding only atmospheric and perhaps other gases and mineral salts. Small wonder that Sir Gowland Hopkins, in his Presidential Address to the British Association in 1933, said : 'Most biologists, I think, having agreed that life's advent was at once the most improbable and significant event in the history of the universe, are content for the present to leave the matter there.' Do you really believe that the theory of evolution dispenses with miracles ?

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I have your letter (p. 191) and find in it very little that needs a reply. Your statement that by artificial breeding changes are produced more quickly than in nature is true. Your further statement that variations occur more frequently in domestic animals than they do in nature is very doubtful. As we do not know what are the reasons for variation it cannot be accepted. Moreover your statement that 'breeders have not bred anything approaching a new species of dog' is, like many others that I have noted, confused and misleading.

This latter statement depends entirely on what you mean by a species. Let us take as an example the St. Bernard and the Pekinese. Morphologically, as we should judge if we found them as Pliocene fossils, they would certainly be classed as different genera. Whether they are physiologically different species, or in other words whether they could interbreed, I do not know. As the question of the production of new physiological species has been settled by other forms of life, it is really not worth while to enquire.

I do not know why the Porto Santo rabbit is not more frequently mentioned. At any rate, *on a question of fact*, Professor W. B. Scott's authority is good enough for me, and, in view of your appreciative references to him in a previous letter, it should be good enough for you also.

With regard to new physiological species, there is no doubt whatever that they have been formed in plants. You throw some doubt on the question whether the two forms of Drosophila are natural or produced by breeding. As we have to hurry somewhat in finishing this revision, I may not be able to look up the *American Naturalist* to settle this, and so cannot press this particular point. It really doe not matter. There are a number of undoubted cases when the mutated fruit flies show very greatly reduced natural fertility with other forms bred from the same natural species, and so, if this particular objection has not been eliminated entirely, it has been reduced considerably. In any case, now the question has been settled with regard to plants, the objection has become even more factious than it was originally.

With regard to theorising, and particularly that of Nilsson, I must acknowledge to some slight prejudice. In the original correspondence you told me that he had a theory of the origin of species from the ground elements of the biological world by the law of great numbers. Consequently, while I am willing to admit that he may be a competent specialist (and do not wish to depreciate his work on the gipsy moth) I am not disposed to take the least notice of his theorising.

Anyhow you should be aware that there is no subject just now on which there has been so much wild theorising as there has about genes. You will find in Julian Huxley's *Modern Synthesis* that biologists are now beginning to realise that gene mutation is not nearly as 'atomic' as has previously been thought. Julian Huxley puts it that a gene variation is modified by the action of other genes. What I think this really amounts to is that the concept of genes is methodological, and, if used too absolutely, disguises what is also a fact—the fundamental unity of the whole chromosome mechanism.

Generally speaking, I am surprised at your undue regard or the *opinions* of individual scientific investigators. Your quotation from Richard Goldschmidt is an example. So far as this discussion is concerned, I am not interested in these opinions. If we are going to place a high regard on the *opinions* of men of science, then evolution is a fact and there is nothing to discuss. If we do not place a high regard on them, why quote them? I do not think we can do better than quote authorities for facts only, not for opinions, though I admit that sometimes it may be a little difficult to draw the line.

I do not think I need say much about X-rays. You have in the chromosome outfit a series of complicated chemical compounds

which in an absolutely unknown way determine the structure of the animal. X-rays in an equally unknown way make changes. Are these changes those which would naturally occur more slowly? Again we do not know. All this seems to me irrelevant. Personally I like Schrodinger's treatment, but this is also theorising and irrelevant. I cannot see anything in this having reasonable bearing on our discussion.

Experimental evidence—*the facts of experiment*—are just what is needed. It is of course a minor point, as the time is so short, and the number of generations so few, but it fits well. This is sufficient, and we can ignore for the present wild and premature theorising.

Yours sincerely,

H. S. SHELTON.

7

EMBRYOLOGY AND EVOLUTION

DEAR DEWAR,

The evidence for evolution is cumulative. To the various types of evidence already considered we must now add embryology. We will start by considering carefully what an embryo is. In the Protozoa there is nothing that can rightfully be so called. In all (or nearly all) multicellular organisms, however, new individuals are formed by sexual reproduction. The sexual reproduction consists of the coalescence of two cells, called male and female, and from the single cell thus formed a new individual is developed. One fact with regard to this embryo needs to be emphasised from the start. The general form of the individual which is developing is determined from the beginning. However similar the embryo may be to those of other organisms at the beginning, or during its various stages, it *is* essentially different. We can, perhaps, best put it that the embryo and the adult are *the same individual.* You, I believe, sometimes emphasise this aspect, and so we can start by taking it as common ground.

Let us now consider how an embryo would be expected to develop on the assumption of evolution, or on the contrary assumption of special creation, either of species or of larger units. It is common ground that organisms change or mutate. Let us consider how this would affect the embryo. Obviously in an obscure and subtle way (probably in the structure of the genes) the embryo is also changed. But the change may or may not be apparent to simple observation. Let us take for an example an increased length of limb. This may be seen in the embryo when the limb structure is first formed. Or it may not be apparent till the last stage of the growth of the adult. Or it may occur anywhere in between. In the second case the embryo is apparently precisely similar to that of the ancestral organism. In the third case it illustrates the well-known fact, which can also in a sense be considered as embryology, that the young of allied species resemble each other more than do the adults. In the first case the embryo gives no evidence for, or indication of, the mutation that has taken place. Consequently the

embryos may sometimes show indications of their ancestry and sometimes may not, and it is not possible *a priori* to say when they will and when they will not. As a matter of fact they usually do, but this cannot be regarded as a universal rule.

I hope up to the present we can regard this as common ground. As you admit what you describe as transformism to a certain extent, you will I think agree that it is reasonable to look for evidence in the embryo for such transformations as you are willing to admit. Vialleton, I understand, admits evolution within the family. Assuming that he regards Equus and Eohippus as in the same family, he could hardly fail to recognise as evidence of evolution the well-known fact that in the embryo horse the second and third toes are much larger in proportion to the third toe than they are in the adult. Nor could he reasonably deny that the fact that in the Merychippus colt the ulna is separate, but fused with the radius in the adult, is evidence of the descent of the species from a form with a normal radius and ulna. The important question that arises therefore is to what extent these indications are actually found. Are they found within the family only? Or is there any indication whatever of a limit within which they are found? I wish to emphasise strongly that here you have an opportunity of testing your theory of units of creation, and particularly Vialleton's suggestion that the unit of creation is the family. If your contention (or Vialleton's) is correct, we should naturally expect fundamental differences in embryological development in different units of creation, but similarity in the species contained in the same unit. If by some extraordinary chance the scientific world should be wrong (which is possible), and you right (which is less likely), it is no use looking for your units of creation in the fossils. There are not enough of them, and the suggestion of the fragmentary nature of the fossil record is one you cannot possibly answer convincingly. But you might find these units of creation indicated by the embryos, as every animal has an embryo. That at least is a reasonable suggestion of one way in which you can find plain and obvious facts which will distinguish between the normal view of evolution and your particular theory.

That is sufficient about units of creation. Now let us look at the facts. The facts are that the embryo does give many clear signs of its ancestral history, more so than could be inferred *a priori*, and that these embryological similarities extend throughout the whole of the phylum. You might possibly make out some sort of a case

for regarding the phylum as a unit of creation, but you could not do it for any smaller unit. So obvious are these facts that they have given rise to the theory that the embryo recapitulates the history of the race. This I do not accept, and regard it as an undue simplification, but the very fact that it has ever been put forward shows how strong the evidence is. One important point to notice is that, in so far as the history of the race is indicated in the embryo, and I think it is so to a considerable extent, the embryo represents not the adult form of the ancestor, but the embryo of the ancestor, which has not been modified to the same extent as the adult form. What it amounts to is that, instead of going in a straightforward way to the formation of the adult form, the embryo develops in devious ways dependent on the fact that it will naturally follow the lines of development of the ancestor unless a further mutation occurs to modify the embryo and make the development more direct. Such modifications can only be expected to occur and survive in so far as they make smaller demands on the mechanism of growth, and so have definite survival value. They do in fact often occur. The best example I can give is the difference between the embryos of the fowl and the duck, which is obvious at a very early stage. These things have to be looked for, and are what can reasonably be expected, but they do not appreciably affect the enormous similarity in the embryological development in different families, orders, and even classes.

We will now give some specific examples of the similarity of embryological development in creatures which are far apart in their classification. Some have already been mentioned. Zittel tells us that the embryo bird shows tail vertebrae similar to those found in Archaeopteryx. What possible explanation is there of this except the obvious one that the bird is descended from a form with a long reptilian tail? Peripatus has an embryological development similar to that of the worm, though its adult structure is related to that of the arthropods. This seems to me good evidence of the genetic connection between worms and arthropods.

Now let us look at an example which is found in the *Origin of Species*[1] in which Darwin quotes a well-known passage from Von Baer:

'The embryos of mammalia, of birds, lizards and snakes, probably also of chelonia, are in their earliest stages exceedingly like one another both as a whole and in the mode of development

[1] Popular edition (1900), p. 605.

of their parts ; so much so in fact that we can often distinguish the embryos only by their size. In my possession are two little embryos in spirits, whose names I have omitted to attach, and at present I am unable to say to what class they belong. They may be lizards, or small birds, or very young mammalia, so complete is the similarity in the mode of formation of the head and trunk of these animals.'

Of course I am aware that a modern embryologist by microscopic work and the method of section cutting could identify at least the class of the embryo, but this is wholly irrelevant in view of what I have said before. There is no doubt that the embryos, in spite of their similarities, are fundamentally different ; but what possible reason can there be for this extraordinary similarity in the process of development except evolution? Darwin goes on to mention the great similarity in crustacean larvae, as illustrated by the barnacle, which in appearance is very unlike a crustacean, but is shown clearly to be one by its embryological development.

It is well at first to grasp main principles, so I will not overload this letter with examples, but will next illustrate them by the well-known branchial arches, often called gill-arches. Six grooved arches, through which pass important blood vessels, are formed at an early stage in the development of all vertebrates. In the ordinary fish four of these grooves become fully cleft and form the gills. In other vertebrates their cartilages usually form other structures, much smaller in proportion than the gills in fish, though in one or two cases, so far as is known, *they disappear entirely*.

Now let us state carefully the evolutionary argument. This structure refers, of course, to the embryo fish, not to the adult fish. The structure has its uses to the embryo, otherwise it would almost certainly have been suppressed. But all sorts of unexpected small organs, such as the thryoid cartilage, are formed from these relatively large structures in the embryo.

It seems to me impossible to account for this on any other hypothesis than that of evolution. On that hypothesis, all through the millions of generations, certain structures of the fish embryo have been retained. No explanation of all vertebrates being built on the same plan will do. No straining of the idea of a plan can equate the ear bones of the mammal with the fish's jaws, or the thyroid of a mammal with the gill of a fish, or another gill of a fish with nothing at all. The early stages of the embryo have remained unchanged, while the later stages have mutated. That is a clear and intelligible explanation, and I know no other.

The extreme similarities of the early stages of the vertebrate embryos are intelligible only in the same way. To a certain extent vertebrates are built on the same plan, but not to that extent. Birds, reptiles and mammals are very dissimilar in many ways, and on any other hypothesis it is not to be expected that their early embryos will be indistinguishable to an expert like Von Baer. But this fact gives very strong support to the idea of evolution, more so indeed than we are entitled to expect on *a priori* grounds.

You asked me about the early history of the vertebrates, and from what invertebrate group they are derived. As fossil remains of soft-bodied organisms are so rare, it is only by an extraordinary chance that geology can give us any help at all. But embryology helps a little. The first sign of the vertebrate column is the notochord—a gelatinous cylinder which forms in the place afterwards occupied by vertebrae. It happens that living creatures exist having no vertebrae, but possessing this dorsal notochord. Amphioxus is the best example. We therefore confidently assert the genetic connection of vertebrates with creatures possessing a notochord, and the combined division is called the Chordata.

At the other end of the scale gastrulation, that is the forming of a double layer of cells from a hollow sphere by its pushing inwards like a punctured rubber ball, is very suggestive. This method of forming the double layer does not appear to have any particular advantage over alternative methods, indeed in special cases it has been displaced by others, but it is undoubtedly the normal method. It is reasonable to infer that a free swimming gastrula form was one of the stages in the development of the higher forms of life. Some existing creatures still retain this structure.

The intermediate stages are obscure. There is some indication of segmentation. The skull is not, as would naturally be expected, formed from a single embryological unit. The gill arches, six in number in most vertebrates, are more numerous in amphioxus, and the Elasmobranch fish show additional vestigial pouches which do not develop. So I think we should look for a segmented creature. The difficulty is the dorsal nervous system. All known segmented invertebrates, so far as I know, have a ventral nervous system. Possibly further discoveries in invertebrate embryology may throw light on the problem.

I will conclude with a few more well-known instances where the embryo has not kept step with the adult, and shows features referring to the ancestral organism.

1. Embryos of some toothless whales have teeth, and the narwhal has a complete foetal dentition. The nostrils (blow holes) of foetal whales are further forward in the embryo, that is nearer the normal mammalian type.

2. The heart of the embryo vertebrate is simple, similar to that of the adult fish. Once again this refers to the embryo fish, not to the adult. One more embryonic feature has remained constant.

3. No less than three successive excretory organs develop in the higher vertebrates. The second, which is the one that persists in the adult fish, is formed in the embryo of higher vertebrates but later on disappears.

4. In tailless organisms such as the primates, the embryo has a pronounced tail.

5. The immature flat fish have eyes on both sides of the head in the normal vertebrate manner. At a later stage of development the eyes come slowly over so that both are on one side.

These special similarities could be multiplied indefinitely, but perhaps the strongest evidence is the extreme general similarity of the early stages of vertebrate embryos, and the way in which the young animals of all orders are usually nearer the normal type than are the adults. The facts in general are beyond dispute. What puzzles me is that anyone acquainted with these facts can fail to appreciate that they add a quota to the overwhelming evidence in favour of evolution. Certainly in embryological development I can find no trace of your units of creation, and am still waiting for some intelligible evidence that these mythical units actually exist.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

Almost the only common ground in the matter of embryonic development is that we agree that in nearly all multicellular organisms every individual begins existence as a fertilised ovum, and the general form of the future individual is determined from the beginning. From this point there is absolute opposition between your views and mine. My method is inductive, yours is deductive. I start off with no preconceptions ; I observe and study the phenomena with the object of trying to probe the marvels of embryonic development and to discover by what contrivances a highly complicated organism inheriting the characteristics of both parents can

be developed in a few weeks from a fertilised ovum of microscopic size. My studies have convinced me that from start to finish the process is the result of intelligent activity and that the difficulties are overcome by a series of beautiful devices. I find, *inter alia*, that the phenomena of embryonic development exhibit two outstanding features and that, when once these are grasped, the reasons for many of the phenomena become clear. These features are :

1. The structural changes through which an animal passes in its embryonic development follow the shortest and most direct route possible to the adult state, compatible with the immediate necessities of life. Among these necessities are an unceasing supply of nutriment and oxygen and the means of ridding itself of carbonic acid and other waste products of the chemical changes that take place within it.

2. The fertilised ovum is endowed with the power of developing at a very early period the tissue-producing cells or primordia of each of the major organs and structures that occur in any member of the phylum or class to which the animal belongs, even the primordia of structures which that particular individual will not need in the adult state : in the case of these the development of the primordia capable of producing them is early checked ; thus the embryo of every higher animal exhibits the primordia of both the male and female generative organs, but in normal circumstances only those of one sex attain maturity.

You start off with the assumption that every animal is descended from a very simple ancestor, and you are intrigued by Haeckel's 'theory that every embryo recapitulates the history of the race.' It is true that you regard this as 'an undue simplification,' but you say 'the very fact that it has ever been put forward shows how strong the evidence is.' For this reason you expect to find in a developing embryo conditions or states that represent 'not the adult form of the ancestor but the embryo of the ancestor.'

You say 'what it amounts to is that instead of going in a straightforward way to the formation of the adult form, the embryo develops in devious ways dependent on the fact (*sic*) that it will naturally follow the lines of development of the ancestor unless a further mutation occurs to modify the embryo and make the development more direct.' Then you say that you regard 'the theory that the embryo recapitulates the history of the race,' as 'an undue simplification.' Apparently you mean that, but for chance mutations that occasionally occur which check deviations, the embryo

recapitulates the history of the race. Then you say 'embryos may sometimes show indications of their ancestry and sometimes may not, and it is not possible *a priori* to say when they will and when they will not.'

Your theory has the advantage of being beautifully easy to defend. For example you say: 'Embryos of some toothless whales have teeth,' and you appear to regard this as a recapitulation of a toothed ancestor; but if I point out that, although you believe living birds are derived from toothed ancestors no living bird shows in the embryo any traces of teeth, you can reply 'their ancestors mutated in such a way that the teeth-stage of development has disappeared!' No one can disprove this, but I can say that your theory involves rather strange pranks on the part of the unknown forces that cause evolution, because the only two living monotremes (egg-laying mammals), both of which occur only in Australasia, lack teeth, but the embryo of one of them—Ornithorhynchus (duck-billed platypus) has teeth, while that of the Echidna (spiny anteater) has no traces of teeth. I assert that teeth occur in the embryos of toothless whales and the platypus because they are necessary to the embryo of these animals, but they are absent in those of the other two because they are not required. A massive jaw cannot develop properly in the embryo unless the jaw has embedded in it teeth on which to mould it, and that is why they occur in all toothless mammals having massive jaws, and in none that have slender, bird-like jaws.

You say I 'might possibly make out some sort of a case for regarding the phylum as a unit of creation, but I could not do it for a smaller unit.' You have to make this admission regarding the phylum because every phylum is constructed on a plan fundamentally different from that of every other phylum; in consequence, in each case embryonic development follows a different course from an early stage of development. But the first steps are the same in every embryo, i.e., the stages by which the fertilised egg develops into a multicellular embryo, because these stages must inevitably be passed through. Mechanical necessity demands it. Every fertilised cell, including its nucleus splits up into two equal parts, thus a two-celled embryo is formed. Then each of these again divides to form a four-celled embryo, this is followed by 16, 32, 64, 128, etc. stages; and all these cells are so arranged that no cell is completely surrounded by other cells; this ensures that every cell obtains the requisite oxygen and nourishment and has a means of

ridding itself of waste products.[1] This is why all embryos generally resemble one another in the earliest stages, but a time soon comes when the further development of each embryo differs from that of embryos of animals of a different phylum. Take the case of the vertebrate embryo. As all vertebrates are constructed on the same plan—the vertebrate plan—which entails bilateral symmetry, a dorsal central nervous system, a dorsal endo-skeleton (notochord or backbone), a head and a tail, and never more than two pairs of limbs, all vertebrate embryos, whether fishes, amphibia, reptiles, birds or mammals, develop in the same way until the general outline of the vertebrate plan is established. This again is a mechanical necessity if the embryo is to reach the adult state in the most direct manner. But, just as the embryos of different phyla develop differently, so do those of different classes within the phylum diverge in development after the stage at which the general outline of the phylum is established, and in the case of the vertebrates, the divergence begins directly the general outline of the vertebrate body is completed and when the features peculiar to any class begin to develop, in this case those peculiar to the fishes. This happens at the stage when the visceral or pharyngeal arches are formed. You incorrectly describe them as 'branchial arches, often called gill-arches.' These have no branchial functions. They form part of the wall of the pharynx and give passage to the blood-vessels carrying blood from the ventral to the dorsal part of the body. A heart and a blood system is indispensable to the developing embryo at a very early stage, long before a complicated heart could be developed, in consequence the early embryonic heart is a very simple one. Two tubes running parallel are formed which fuse into one to form a single tube, then the wall in front thickens, and the thickened part becomes separated by valves from the thinner part behind. The heart is now an efficient pumping organ composed of two communicating chambers : a posterior one, the auricle, that receives blood from the body, and an anterior one, the ventricle, which by the contraction of its thick wall, expels the blood into the arteries, the back-flow being prevented by the valves between the two chambers. The blood passes from the heart into a ventral vessel, which bifurcates, and each branch of this ventral aorta pushes forward until it reaches the first or foremost visceral arch, through which it runs until it enters the dorsal aorta. No sooner has this connection been established when in quick succession four more vessels are formed behind

[1] The formation of a gastrula is one of these devices.

that running through the first arch, these run through the other four arches, and so the ever-growing need of the head for blood is satisfied. Thus these arches and blood-vessels are indispensable to every vertebrate embryo at one stage of existence. They are a beautiful device for giving the head region the necessary blood, and I cannot think of any other practicable, much less better, method of securing this. Therefore I maintain that it is absurd to assert that these arches are formed because all higher animals are descended from fishes. Far from giving evidence for evolution these arches and their subsequent fate in the embryos of fishes on the one hand and those of air-breathing vertebrates on the other is very powerful evidence against the notion that a fish was ever gradually changed into an amphibian. As this is a matter of paramount importance, I am dealing with it in detail, although it makes a large inroad into my allotment of words.

In the fish embryo the tissue between each of the arches becomes absorbed and thus are formed the gill slits, and these grow wider. Meanwhile gills begin to grow on arches 3, 4, 5 and 6 and the blood-vessel in each of these arches divides longitudinally into two vessels that run parallel, one of which is connected with the main dorsal blood-vessel and one with the main ventral one. Then a network of tiny blood-vessels is formed in each arch which puts the parallel blood-vessels into communication and extends into the growing gills. By this arrangement the blood that comes from the heart in a venous or impure condition flows into the gills where it is aerated ; then it passes into the dorsal blood-vessel, thence to all parts of the body. None of the above events happen in the embryos of air-breathing vertebrates.

Now, you believe that some fish gradually turned into an amphibian and later one of these became changed into a reptile. This means that all the gill apparatus described above gradually disappeared, as did the third and fourth gill-arches of the fish, lock, stock and barrel, for *no trace of them occurs in any adult amphibian, reptile or bird*, but later they reappear from the blue to form the thyroid cartilage (Adam's apple) and the epiglottis (the leaf-like cartilage that forms a lid for the windpipe) in mammals. Yet not a hint of the above enormous changes is shown in the embryonic development of any amphibian, reptile, bird or mammal—the embryo develops as if fishes never existed. Do you believe that embryology lies to this extent? Do you seriously believe that, after they had done their work in affording a path to blood-vessels

required by the embryo in its early stages, these arches not only performed no later function, but completely disappeared. Then suddenly after millions of years they not only persisted instead of being absorbed but actually gave rise to *two entirely new organs*—Adam's apple and the epiglottis? Do you believe that these two organs originated gradually? Can you say of what use they were in their incipient stages?

If you really hold that the heart and blood-vessels develop in air-breathing animals in the way in which they do because these animals evolved from fishes, please say how you think the heart and blood-vessels of a vertebrate that never had a fish ancestor, but was first created as an air-breather, ought to have developed. As on this matter you and I differ *toto caelo*, I must ask you to support your views by describing *in detail* the process of the origin and development of its embryonic blood system.

The above is not the only absurdity of the evolutionary interpretation of the embryonic visceral arches. To repeat what I said on page 50 of *The Difficulties of the Evolution Theory* (1931): 'In no known fish do all the so-called gill arches give rise to gills. . . . In Elasmobranchs the mandibular arch forms the jaws of the adult. If the evolution theory be true that can only mean that . . . some unknown vertebrate lost its original mouth and used its first gill-arch as one!'

I hope that you will tell me and the jury how this happened, and why.

You cite as evidence for evolution and recapitulation the fact that 'no less than three successive excretory organs develop in the higher vertebrates.' I assert that these successive kidneys are an absolute necessity to every higher embryo, evolution or no evolution. As a kidney is a *sine qua non* of existence at a very early stage of embryonic development, long before a complicated one has time to develop, a very simple kidney, the pronephros is first formed. This consists of a row of two or three nephridia on each side of the body. These nephridia are minute tubes, one end of which opens into the body-cavity and the other into a common duct running along the length of the body leading to the exterior. Each nephridium comes into contact with a bunch of tiny blood-vessels known as a glomerulus. The waste products of the body are taken up from the blood by these nephridia and pass into the common duct and so out of the embryo. As the embryo grows, new nephridia arise behind the first ones. These are of more complicated nature and

so are described as a second kidney, the mesonephros. As these increase in number the simple pronephros disappears. A kidney of the mesonephros type suffices to carry off the excretory products of a comparatively simple animal, it therefore persists in fishes as the permanent kidney. But a mesonephros is inadequate for the needs of more complicated animals, in consequence a far more elaborate kidney, known as the metanephros, is developed behind the mesonephros. When at last this new kidney is ready to function, the nephridia of the mesonephros become absorbed, but their common duct persists and is used to convey male genital products. Thus, in my view, these three successive kidneys are a necessary and beautiful device for meeting the needs of the embryo while the final type of kidney is being developed ; and as this is a vital point of difference between us, I think that, if you do not agree with me, you should show exactly how you think the kidney of a specially-created air-breathing animal ought to have developed in the embryo. Please give at least as complete details as I have done.

To return to the visceral arches. You say, 'All sorts of unexpected organs, such as the thyroid cartilage, are formed from these relatively large structures in the embryo.' Why you should expect all these arches, after having completed their embryonic functions, to disappear without being utilised is beyond my comprehension. *Inter alia* they form the lower jaw, Meckel's cartilage, the bones and other parts of the ear, as well as the thyroid cartilage. All these organs develop at the place where they are required.

You say 'in tailless organisms such as the Primates, the embryo has a pronounced tail,' and suggest that this is evidence that 'tailless' vertebrates are descended from tailed ancestors. By tailless I presume you mean those animals, such as anthropoid apes, of which the tail does not stick out behind the body. I know of no tailless vertebrate. Under the vertebrate plan of construction the hind limbs and girdle invariably arise from a part of the vertebral column some way from the hind end, and the part behind this girdle forms the tail. This, like every other organ, takes different forms and is put to various uses, and during embryonic development it becomes modified to become longer or shorter to suit the needs of its possessor. It may vary in length considerably in different species of the same genus, thus in Felis it may be composed of as many as 29 or as few as 13 vertebrae.

As the primordia of the eyes in every vertebrate are on each side of the head, those of flat-fish are necessarily formed there.

But organs in the embryonic and larval stages very often change their original position. In such cases the adjacent parts of the embryo afford facilities to the moving organ ; in flat-fish a part of the bar of cartilage above the eye about to migrate to the other side of the body becomes absorbed so as to allow an easy passage to the eye. This gives the process the appearance of being intelligently directed.

In citing the eye as evidence for evolution you are treading on dangerous ground, because the eye develops in the vertebrate embryo in such a manner that until almost completely developed it could not function as an organ of sight. This fact is very unfavourable to your idea of the gradual evolution of the eye from a patch of integument sensitive to light.

Your reference to amphioxus and the notochord put me in mind of a drowning man grasping at straws to save himself. As amphioxus and many fishes thrive quite well with a cartilaginous notochord or backbone, it is up to you as an evolutionist to explain why, if all the primitive vertebrates had such a spinal stiffening, any went to the pains of replacing it by bony structure ! If you think the change took place gradually, please describe the stages, and say what caused the change ?

In the vertebrate embryo the backbone necessarily begins as a cartilaginous rod because, while the embryo is developing every part of it needs a continuous supply of nourishment, and the nature of bone is such that the presence of numerous small blood-vessels is necessary for its development. These are not necessary for the growth of membrane or cartilage, which, in consequence can be formed in the embryo at a time when the production of bone is not possible. Moreover, cartilage can grow interstitially, bone cannot. As soon as the embryo is sufficiently advanced to enable blood-vessels to form, ossification begins. As ossification is a slow process, in order to expediate it, the ossification of every vertebra and every bone in the body is effected from several centres.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

There is not much in your last letter that calls for a reply. I note that you think your method is inductive. I suppose you mean something ; but I have not the least idea what you do mean.

Once again your arguments are too subtle for me. So indeed are your interpretations of my letters. As has happened often before, I fail to recognise my own statements under the disguise of your travesties. Why, for example, you think I expect 'all these arches after having completed their embryonic function to disappear without being utilised' is beyond my comprehension. I don't. My point is exactly the opposite. The thing that seems to me remarkable is that occasionally they *do* disappear, and others, instead of forming considerable structures, form insignificant ones such as the thyroid cartilage. I regard this passage, and much of the same kind that occurs from time to time, as natural. The arguments for evolution are so plain that you need to shut your eyes to them or they would be convincing.

What are you trying to say all through this letter? You certainly have not made any attempt to answer my arguments. You say that 'the process (of embryological development?) is the result of intelligent activity.' What do you mean? If you mean that the process has been intelligently designed, of course I cannot answer that; but it looks as if you meant that the embryo is intelligent.

Again you say: 'the structural changes through which an animal passes in its embryonic development follow the shortest and most direct route possible to the adult stage compatible with etc., etc.' But they don't. And how do you know what is possible? The example of the branchial arches (or whatever else you like to call them) is plain evidence to the contrary. You say something about the development of the blood-vessels. Have you noted how they start with a bilateral symmetry, how this is modified and a number on one side disappear, and how finally a new approach to bilateral symmetry is formed? This enables me to answer your question. If there had been no evolution I should have expected a *direct* development to the blood-vessels of the adult form. Similarly, I should have expected only one kidney to be formed, and this to develop gradually, as required by the needs of the organism, to the adult form.

'The fertilised ovum is endowed with the power of developing at a very early period the tissue-producing cells or primordia of the major organs or structures—even the primordia of structures which that particular individual will not need in the adult stage.'

Exactly. That is what I have been pointing out as evidence for evolution. Most birds have only one functional ovary and oviduct,

but two are developed, and one remains as a vestige in the adult. Why? Does the embryo bird need two ovaries and oviducts? Is this the simplest and most direct route towards the adult stage? The obvious explanation is that the ancestor of the bird had the normal two ovaries and oviducts and that, in the subsequent evolution, the embryo has not kept step with the adult. What other explanation is there? Similarly the adult snake has only one functional lung, but two are developed in the embryo, and one remains as a vestige in the adult. The evolutionary explanation is obvious. What other explanation is there?

You say that although the embryos of toothless whales have teeth, those of birds have not. How do you know? If you will look at a modern book on embryology (such as that of Sir Graham Kerr), you will find this mentioned as a doubtful point. On the other hand, Prof. W. B. Scott in his book on evolution says quite definitely that the embryo teeth are there. I am not competent to settle this disputed point, nor I think are you, but at least you should not dogmatise on the basis of ignorance. It might perhaps have occurred to you that the rudiments of teeth are more difficult to discover in a small jaw, like that of the birds commonly used in embryological study, than in that of the whale. It is not necessary, however, for me to trouble about doubtful points. The undisputed ones are quite good enough.

You make some remarks about tails and find fault with me for describing man and the apes as tailless vertebrates. Of course, I am as well aware as you are that we and the apes have vestigial tails. That is good evidence for evolution. But I cannot understand what it is you are trying to tell me. In man and the apes the tail is much more prominent in the embryo than it is in the adult. Similarly, the tail of the embryo bird, as Zittel pointed out, is remarkably similar to that of the adult archaeopteryx. Why? On the assumption that all these forms are descended from animals with considerable tails this feature is intelligible. It is evidence for evolution. I cannot see that you have given us the glimmer of an alternative explanation.

I cannot find anything further in your letter that requires an answer. The development of the embryo in general, *and particularly the striking similarity of the embryos of different classes*, contain unmistakable evidence for evolution. Sufficient examples have been given. Your answer seems to me to cloud the discussion with a mass of detail, none of which contains any facts which do not fit

well into the evolutionary explanation. I suppose, if you have no case, that is as good a method as any other. Let us therefore bring the discussion back to the point where I left it in my last letter.

You (and even more, Vialleton) admit what you call transformism to a certain extent. What happens to the embryo when this occurs? Does it keep step with the adult? Or does it give evidence for such degree of 'transformism' as you are willing to admit? Finally, if the embryo develops directly to the adult, as you appear to contend, it is fairly obvious that (shall we say) a snake, a bird and a rabbit will develop entirely differently. Do they develop in such an entirely different way as would be expected from their adult forms? Also, if as you suggest there are units of creation, whether species or larger units, should we not rightfully expect that the different modes of development of the embryo will give us some idea what these units are? Can you find any such indications in the structure of the embryos?

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

You say that there is not much in my last letter that calls for a reply. This is rather surprising in view of the five vital questions I put to you, questions going to the very root of embryonic development:

(1) Regarding the origin and development of 'Adam's apple' and the epiglottis.

(2) A request to make good your assertion that the development of the heart and blood-vessels (described by me in detail) takes a devious course, by describing how these should have developed had mammals not descended from fishes.

(3) As according to your theory some vertebrate lost its original mouth and used its first arch to make a new mouth, I asked you to tell us how this happened, and why?

(4) A request to you to make good your assertion that the development of the mammalian kidney (which I described) does not follow the most direct way, by describing, in at least as great detail as I have done, how the kidney ought to have developed had mammals not had fish ancestors.

(5) If you believe the earliest vertebrates had only a cartilaginous spinal stiffening, I asked you why this became replaced by a bony

one, and, if the change took place gradually, to describe the stages and say what caused the change.

You have completely ignored Nos. 1, 3 and 5 of the above and have disposed of Nos. 2 and 4 in eight lines !

You try to show that my feature No. 2 of embryonic development favours the theory of evolution. You ask does the embryo bird need two ovaries and oviducts ? The answer is : No, it needs them no more than a male mammal needs female organs or a female male organs ; nevertheless, they occur in the embryo. On your interpretation this means that the earliest mammal was an hermaphrodite. Do you seriously believe this ? You are doubtless aware that no known mammal, bird or reptile exhibits the phenomenon of hermaphroditism. Do you believe that the mammae on the breasts of men are relics of a golden age in which the men suckled the babies ? Nor is this the only difficulty you have to meet. Every reptile has two aortae, while all birds have only one —the left, and all mammals also have only one—the right. If your interpretation be correct, then in the past some reptile lost its right aorta and became a bird, while another lost its left aorta and became a mammal. Do you really believe that these strange things happened, and that gradually by the accumulation of small fortuitous variations ? Can you suggest any reason for the complete change in the system of blood circulation ?

I put it to you that you have utterly misunderstood the principles that govern embryonic development. Although the idea of any plan or design in the animal world is very distasteful to many people, there is no getting away from the fact that every phylum is constructed on a definite plan. This imposes the idea of a law or rule. That there are laws of organisation in the animal world is shown by the fact that everyone of all the millions of species belongs definitely to one or other of about ten types, each designed on a different plan. These types are the phyla ; below these are about sixty smaller types—the classes. One of the most striking features of the organic world is that it presents such a variety of different expressions of each of these types. In the vertebrate phylum there are the fishes, amphibia, reptiles, birds and mammals. In the cases of the fishes and birds there are about 15,000 expressions (species) of each. If any member of any type ever became changed into another—for instance, an amphibian into a reptile or a bird into a reptile—the conversion must have been sudden—a special creation.

It is not easy to explain embryonic development in non-technical terms, but at the risk of being tedious I will try to convince the jury of the fallacy of your views. Let us take the tail. In the developing embryo, after the original cell has become sub-divided into more than a thousand cells, these arrange themselves in every vertebrate embryo into three basic layers known as the ectoderm, mesoderm and endoderm which enfold each other. The embryo is, so to speak, built up round the notochord—the cartilaginous precursor of the backbone. The nerve tube is the first product formed by the ectoderm, and the primitive vertebrae immediately below it are that of the axial mesoderm. These proto-vertebrae are formed all along the whole length of the body. Thus the embryo at this stage exhibits a chain of segments, the function of which is to produce vertebrae, muscles and nerve fibres. In no living or known extinct animal is the body composed of a number of exactly similar segments, not even the earthworm, hence this condition does not represent any possible ancestor. These segments or metameric primordia are indispensable to the embryo and are purely embryonic structures. Although in outward appearance all are alike, each develops on lines peculiar to itself. The members of this series of primordia behind the spot at which the hind limbs bud out from the embryo give rise to the tail of the adult, be it long or short. According to Keith, the human embryo displays from eight to eleven of these incipient tail vertebrae. This is about the number found in *every* vertebrate embryo, whether the adult tail as in man and the anthropoids, is composed of four or five vertebrae or of 40 or more as in some long-tailed mammals. In some embryos the number of vertebrae increases during development, in others it remains constant, in others it diminishes, as in man. The human tail begins to diminish when the embryo is from 8 to 9 mm. long and by the time the embryo is 25 mm. long the whole of the vertebrated part of the tail has been withdrawn into the body. The vertebrae of this part fuse to form the os coccyx which soon becomes bent forward and serves for the attachment of certain important muscles. The fact that the tail is thus curved enables man to sit down without discomfort and probably affords the additional support for the viscera needed on account of man's upright posture. Notice that in its earliest state the tail of man is as long as that of a long-tailed animal. If man be descended from a long-tailed ancestor, it is reasonable to suppose that this organ would have in the course of time gradually become shorter at its inception, but

this does not happen. As you assert that man in his embryonic development recapitulates various stages of tailed ancestors, please explain why, in the whale (which you suppose to be descended from ancestors having well-developed hind-legs), the embryo does not exhibit at an early stage well-developed legs which later shrivel up? Why this difference in the two cases.

Here is another question for you. If the human embryonic tail exists only because man is derived from a tailed ancestor, how do you account for the fact that the human alimentary canal in its earliest condition extends in front of the mouth region and behind the vent, i.e., at that time there is a pre-oral and a post-anal gut? Do you seriously suggest that this is a relic of an ancestor which possessed a length of disgestion tube in front of the mouth and behind the anus? Clearly both the embryonic tail and the pre-oral and the post-anal gut of man appear in obedience to the laws that govern the development of every embryo.

To the question, why does the tail develop in this way, why does it not develop as legs do by being budded from the body, the reply is that, as the legs require nourishment during development, they have to be budded not at the extreme hind end of the body but a little way from this, and it is more simple to make use of the vertebrae existing behind the limbs than to scrap these and form new bones behind them. In this connection let me point out that there is no such thing as waste in nature: it is not wasteful to develop structures that are subsequently absorbed, or for an animal to lay millions of eggs of which only a few reach maturity. In each case the material employed is subsequently used, again and again.

As to the paired lungs of snake embryos and the paired ovaries of bird embryos, this involves no loss of time because these are developed simultaneously.

You are not quite accurate in what you say about Vialleton and me. Neither of us admit any degree of what we call transformism. The sub-title of Vialleton's last book is *The Transformist Illusion*. We both believe that animals are capable of limited modification. My views are thus expressed (*More Difficulties of the Evolution Theory* (1938), p. 178): 'I submit that this expression (i.e., "evolution within the family") reveals a defect in Biological terminology. It is unfortunate that the word used to describe the supposed gradual transformation of an amoeba into an elephant is also employed to describe the insignificant modifications which

animals undergo when subjected to new conditions of life. It would make for clarity and precision if these minor changes were described as differentiation rather than as evolution.

'This would not prevent the evolutionist from trying to show that differentiation is the first stage of evolution.'

Vialleton makes a similar distinction, but his terminology, being applicable to French-speaking people, is different. What I suggest should be called evolution he terms transformism, and he uses the word evolution to describe what I call differentiation. He, like me, laments the confusion in France between transformism and evolution, and in places he calls the latter Diversification.

A snake, a bird, and a rabbit do develop entirely differently after their embryos have reached the stage in development when divergence becomes necessary in order to form in the most direct way the characters in which they differ. So long as they are developing the basic features that characterise the vertebrate phylum they, of course, do not develop differently. Only one straight line is possible connecting two points. The small differences that distinguish species within the family are the last to develop.

In reply to your question whether there are any indications in the structure of embryos to show what the units of creation are, there are such indications. Here are three :

(1) The phenomena of embryonic development demonstrate that, if a member of one phylum ever became converted into a member of any other phylum, the conversion must have been sudden, by a change in the direction of the development during the period of segmentation or very shortly after.

(2) If within a phylum any member of a Class became transformed into a member of another Class, the transformation must have been effected *per saltum* by a change in the embryo ; for instance, in a vertebrate at or before the time of the appearance of the visceral arches. This precludes the idea that any air-breathing animal had a fish ancestor.

(3) If within the Class any member of any order ever became transformed into a member of another order, the transformation must have been sudden and effected by a change in the direction of embryonic development at an early stage ; for example, if a whale be descended from a land quadruped, the event that caused this must have been a change in the direction of the development of the embryo at or earlier than the stage of development when the primordia of the limbs are buds as broad as they are long.

Let me make it clear I do not say that such changes have been effected. We have no means of knowing, but if they have, they must have been effected as above, and so would be what I call special creations.

Dr. de Beer, who is an evolutionist, shows (*Embryology and Evolution*, pp. 86, 90, 104) there is no logical justification in regarding an embryological stage as evidence of such a stage representing an adult ancestor. Equally well might a present adult stage represent an embryological stage of an ancestor.

In conclusion, if I be wrong in saying that no embryo bird exhibits teeth, all you had to do to put me right was to name birds that do show this, or a single bird, and say who discovered this and where the record of the discovery is to be found. You have chosen, without giving references or quoting any statement, to say that modern books on embryology state that it is doubtful if such teeth occur and that W. B. Scott in a book (unnamed) on evolution says quite definitely that these teeth are there. Then you suggest that these supposed teeth are so minute as to be very difficult to see, apparently even under the highest powered microscope! I have not been able to find a single authentic record of such teeth. For this reason please let me have the reference to such a record. I am aware that it used to be thought that teeth occurred in parrots, but it was shown that these were not teeth, but skin papillae, like those under the hoof of the horse, of which the function is to nourish and replace the wear and tear of the beak. I also read in a popular book that someone is supposed to have discovered embryonic teeth in some kind of tern. No reference or details were given, and I have not been able to confirm this. As Scott specialises in mammals it looks as though in his little book on evolution he is relying on hearsay. But let me know what he says and above all give me the name of the bird or birds (with full references to the original record), said to have such teeth. This is a matter of some importance. If these teeth do occur, it becomes important to discover why such an unusual feature is exhibited by the bird or birds in question. Is it not strange that these teeth are not cited along with those of the embryos of whales and platypus as evidence of evolution?

Please pardon me for misunderstanding your remarks about the fate of the visceral arches. As the initial size of these arches is conditioned by that of the blood vessels they contain and as there are no large structures in the head or neck region where these arches occur, your statement, as you have since expounded it,

is to me more incomprehensible than it was before you enlightened me. Perhaps you will name five pairs of comparatively large organs or structures which you would have expected to be produced from these arches.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

Once again a brief reply is all that is needed. I will consider points 1 to 5 at the beginning of your letter. You say you have put to me five vital questions, but I cannot see that they are in any way vital. Let us take them seriatim :

(1) Regarding the origin and development of the Adam's apple and the epiglottis, I find a very complicated argument in the form of a question. Had you put it as an argument it might have been intelligible and worth an answer. As you put it in the form of a question, it is much too involved to reply in the form of an answer, and I am obliged to ignore it.

(2) *The Blood-Vessels.* I don't know how they would have developed if mammals had not descended from fishes, but they would certainly have developed more directly than they do.

(3) I never said anything about a vertebrate having lost its mouth. I believe the first arch forms the *lower jaw*, not the mouth. The earliest fishes we have discovered were jawless, and so probably also were the ancestors of modern fishes. Of course, I cannot tell you in detail the stages by which the jaw was developed.

(4) *Kidneys.* I cannot in any circumstances undertake to elucidate how an organ *ought* to have developed, and certainly not in any detail. It should be obvious, however, that one kidney is simpler than three.

(5) *The Vertebrae.* It is surely obvious that a mobile creature, especially one that grows to any considerable size, needs some reasonably rigid organ to which the muscles can be attached, and that a vertebrate column is in that way better than a gelatinous notochord. Needless to say, I cannot tell you the exact stages by which the vertebral column has developed. Anyhow, this is not an embryological question.

I note your comparison between the two oviducts of the birds and the male and female organs in the embryo. But surely, as every embryo has descended from both male and female ancestors,

this does give some sort of explanation why both organs are found in the embryo. In the same way, the only explanation I know why the two oviducts have developed in the birds when only one is functional is that they are descended from ancestors which had the normal two.

You ask for a reference for my assertion that the presence of teeth in the bird embryo is a doubtful point. On p. 330 of Sir Graham Kerr's text-book of embryology you will find the following passage: 'In modern birds a transitory epidermal thickening has been interpreted as the vestige of a dental lamina, but this evidence is not convincing. Careful researches in this direction in the less highly specialised birds are highly desirable.' There may be a slight shade of difference between embryo teeth and a dental lamina, but it does not seem to me to be significant. Prof. W. B. Scott's treatment will be found on pp. 70–71 of his little book on evolution. I said quite clearly in my last letter that this is a doubtful point, and so lay no stress on it. I merely objected to your dogmatism on an unsettled question.

I cannot make sense of your remarks about the paired lungs of snakes and the oviducts of birds. You say: 'this involves no loss of time as they are developed simultaneously.' What has this to do with the matter? The argument is that these organs are there because they are the remnants of organs which were functional in the remote ancestors, and have not been entirely eliminated. That is the evolutionary explanation and I know of no other.

I have really no more to say. In my first letter I put forward a number of arguments intended to show that the embryo gives many indications of its ancestry. I also pointed out with great care that if by any chance the scientific world was wrong, and there were such things as units of creation, it would be possible to find in the embryo indications of what those units are. Instead of answering you appear to me to have clouded the discussion with a mass of detail. I decline to be drawn into a detailed discussion of minor points. The argument of my first letter is there, and the reader must judge whether you have given any adequate answer.

Yours sincerely,

H. S. SHELTON.

8

ARE THERE NASCENT AND VESTIGIAL ORGANS?

DEAR SHELTON,

If the evolution theory be true and evolution still going on, the majority of animals should exhibit some nascent and some vestigial organs or structures, i.e., organs in an incipient or partly developed condition—organs that are to be of future use, and organs that are undergoing degeneration, because, owing to changed conditions of existence, they are no longer required. *The number of nascent organs should be about equal to that of vestigial ones.* But, as I said on p. 25 of my *Difficulties of the Evolution Theory* (1931) : 'Although the anatomy of thousands of species of animals has been carefully studied, it is impossible to adduce in any species a single structure which is indubitably or even probably in a nascent condition.' This statement was not challenged by Dr. Morley Davies in his *Evolution and its Modern Critics* (1937), which was 'primarily designed to be a reply' to my book.

The absence of nascent organs is a formidable objection to the evolution theory. Darwin recognised this and, characteristically, passed it over in a few words, saying 'it is difficult to distinguish between rudimentary and nascent organs' (*Origin*, 6th Ed., p. 298). He suggested in a half-hearted way three structures which he thought might be deemed to be in a nascent condition. As it can be shown that these are not nascent organs, evolutionists from A. R. Wallace onwards have with one accord kept complete silence on the subject of nascent organs. Although a chapter of my book is headed 'Nascent and Vestigial Organs,' the word 'nascent' does not occur in Dr. Davies' reply, but he devotes several pages to vestigial organs. The word 'nascent' is taboo in transformist society!

This, as in the case of most taboos, has not been imposed without reason. The existence of vestigial structures is regarded by many as evidence of evolution, and, if nascent structures existed side by side with them, these vestiges would be good evidence for evolution ; but the *presence of vestiges coupled with the total lack of nascent structures and organs is evidence against evolution and in favour of*

special creation. The existence of nascent organs is as essential to the evolution theory as is that of fossils of transitional forms. Even as the rocks have not yielded the latter, so the bodies of living animals fail to display the former.

If each type of animal be an independent creation, we should expect it to be endowed at the time of its creation with all the organs necessary for its existence in the conditions prevailing at that time. It might well happen that subsequently conditions changed and in consequence an organ originally useful ceased to be so and then disappeared or became vestigial. This seems to have happened in the case of some, at any rate, of the insects living on wind-swept islands. For example, many on Madeira lack wings or have wings too small to permi them to fly ; the insects on one of the stormiest spots on the earth, Kerguelen Island, are all incapable of flight. In the laboratory cultures of the winged fly, Drosophila, an individual is occasionally born that lacks wings, or in which wings are replaced by knobs or are very small. These 'sports' seem to be the consequence of one or more of the genes that control the development of the wings being inhibited in some way from fulfilling their normal function. Doubtless such freaks are born in nature. Ordinarily their inability to fly results in their being killed before they produce offspring, but on a wind-swept island such freaks being less liable than individuals having well-developed wings to be swept out to sea and drowned, may have lived to produce descendants, many of which have inherited the ill-developed wings, and in some cases these forms may have displaced the winged ones. But it is only in exceptional circumstances that these defective individuals would be preserved, and this explains why so few vestigial structures occur in animals. Let me here say that fully 90 per cent of what are commonly described as vestigial structures are nothing of the kind. In the mistaken belief that vestiges afford evidence for evolution and because such evidence is so difficult to obtain, many transformists describe as vestiges (1) muscles, tendons, bones, etc., which are less developed in a species than they are in most species ; (2) structures of which the use is not known ; (3) what Vialleton well calls embryonic remains.

A few transformists even go so far as to cite as useless vestiges, structures of which the use is known, but not to them on account of their ignorance of anatomy. As examples of such let me cite Dr. Julian Huxley, and Messrs. H. G. and G. P. Wells, who in their *The Science of Life* have inserted a section headed 'Man's

Body: A Museum of Evolution' (pp. 410–14), in which they solemnly assure their readers that such important structures as the body hairs of man and the fleshy fold in the corner of his eye are useless vestiges, 'each one of them a stumbling block to the believer in special creation but an ally to the Evolutionist.' There is perhaps some excuse for this display of ignorance in the case of the eye, but the uses of the human body-hairs are fully described in every good text-book of human anatomy.

As already stated, embryonic remains are either structures of use only in embryonic life, or structures resulting from the laws of embryonic development, so ill understood by many transformists. Examples are the organ of Rosenmüller in female mammals, the mammae of male mammals and the right ovary and oviduct of birds.

In conclusion, I may say that some transformists realise how rare vestigial structures are. Thus E. S. Goodrich, late Regius Professor of Zoology at Oxford, writes (*Ency. Brit.*, Vol 8, p. 926): 'It is doubtful whether any really useless parts are ever preserved for long unless they are insignificant, and many of the so-called useless organs are now known to fulfil important functions.'

Some structures exist of which the uses are not at present known; but it is rash to assert that these are useless. It may well be that the assertion, 'the number of useless organs is the measure of our ignorance,' will eventually be found to be correct.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I think the difficulty about nascent organs is artificial and due to confusion of thought. There is a sense in which a great many organs can be described as nascent, and there is another sense in which there is no such thing as a nascent organ. Let me try to explain this as clearly as I can.

The sense in which nascent organs do not exist is the teleological sense. Except by some extraordinary chance (which is just possible but never to be assumed) no organ will develop unless, even in a rudimentary condition, it has survival value of some sort. As an example, I carefully explained in the first chapter that I thought incipient feathers were useful as an adaptation ensuring warmth *even in their rudimentary stages*. Similarly, while there are many grades

of complexity in the organ of sight, each one is useful to the organism. These organs are nascent in the sense that they are crude compared with the corresponding organs of other creatures. They are nascent in the sense that they are capable of further development, and may possibly develop further if there is a change in the conditions of life; but there is no necessity for them to do so. Similarly, as I explained in the chapter on morphology, the flying fish and numerous other creatures have nascent flying organs. They are reasonably well adapted in each case to the conditions of life of the animal, and, as a rule, there would be no advantage in their further development. Should, however, conditions change, as for example if there were no birds or bats in that particular neighbourhood, we should expect them to develop into efficient flying organs.

To summarise this briefly: the whole animal world is full of nascent organs in the sense of organs capable of further development. Obviously, as we cannot forecast the future, it is impossible to say which are nascent in the sense that they *will* develop further. There are no organs which are nascent in the sense that they *must* develop further. I hope this clears up your difficulty, and that this particular case of confusion can be eliminated from the discussion.

Now let us consider vestigial organs. You admit their existence to some extent, as for example the vestigial wings of insects on oceanic islands. I wish you would avoid question-begging epithets such as calling this plain adaptation to unusual conditions the survival of freaks. As, however, you agree that the wingless insects on oceanic islands are probably descended from winged ancestors, by what process of reasoning do you distinguish these from other cases of the same kind? For example, a considerable number of beetles have rudimentary wings. So have the whole of the order Aphaniptera (fleas). In these and many other cases the insects are wingless but show plain traces of the rudiments of wings. If you are going to admit that all these are descended from winged ancestors, that is evolution, and if you do not admit it where do you draw the line?

You refer me to that excellent book the *Science of Life*, and I have read again the section you mention, which seems to me a good one. May I say in passing that it would be more fitting, and more modest, if you would modify your tone both about the book and the authors. Julian Huxley ranks high as a biologist. G. P. Wells is a thoroughly competent biologist of the younger generation, and even H. G. Wells, who is the least competent as a biologist, took first class honours in zoology in his degree examination, and

is the author of a text-book of biology which is still used. Mistakes are possible, even probable, in so extensive a work, though I do not remember finding any myself, or having any pointed out to me by you. With regard to the points you mention, you speak of 'this display of ignorance in the case of the eye.' Perhaps you will be good enough to enlighten their ignorance and mine. I know that this particular fold is more liable to inflammation than any other part of the eye structure, but I do not know its use. Moreover, with regard to the hairs on the human body, I have studied this to some extent, though I do not claim to be an expert, and have come to the conclusion that they have no use, or none of any consequence. Perhaps you will enlighten us in that matter also, and at the same time you might be good enough to tell me your interpretation of the 'goose flesh' effect, if you do not agree with the obvious one given in the *Science of Life*.

All this, however, is a side issue. I am not impressed by your quotation from Prof. Goodrich, as there are so many insignificant vestigial organs that it is quite superfluous to trouble about any others. All the same, I agree that it is difficult to be sure whether or no there is some use in many vestigial organs. It does not seem to me to make much difference. A vestigial organ adapted to some minor use is nearly as good evidence for evolution as it would be if it were useless.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

When I assert that no nascent organ or structure occurs in any animal I mean that no animal possesses in any incipient or very incomplete condition any organ or structure not found in a very well-developed or complete state in *any* animal. In this connection I will repeat what I wrote on p. 51 of *More Difficulties of the Evolution Theory* (1898) : 'Consider the significance of this absence of nascent organs. According to the evolution theory all multicellular animals are derived from one-celled ancestors, which exhibit nothing that can be called an organ in the strict sense. Consider now the vast number of organs and structures which are supposed to have evolved in the descendants of these organ-less ancestors ; every differentiated cell, bone, cartilage, muscle, tendon, nerve, blood-vessel, ganglion, hair, feather, scale, spine, shell, spur, antler, horn,

hoof, claw, nail, tooth, tusk, antenna, appendage, every internal organ from the blood corpuscles to the stomach and liver. Every type of each of the above organs, according to the evolution theory, must have at one time existed in a nascent condition. Now consider the million or so existing species of animals, all of which are supposed to be in a state of flux, evolving. If these species be really evolving, the majority ought to exhibit nascent structures in all states of development, from unrecognisable excrescences to structures almost ready for use. Not a single one seems to exist! I know of only four explanations of this lack of nascent organs. (1) Every type has been separately created with all its organs. (2) New structures arise, in animals not gradually but *per saltum*. (3) Evolution no longer operates; it is a thing of the past. (4) That the capacity of evolving has ceased in the vast majority of animals, but is the possession of a few of them. Now, of the above, (1) and (2) are creationist and (3) and (4) are evolutionist explanations.

Such nascent new organs are quite easy to imagine, e.g., partly developed eyes in the buttocks of herbivorous animals, or glands of which the use is not apparent but which are on the way to becoming glands manufacturing a fluid that blinds an animal into whose eye it is ejected, and together with this the half-developed apparatus for squirting the fluid, or an incipient or half-developed fly-whisk on the neck of an animal to which flies are troublesome. The tail, which is often an effective fly whisk, does not reach to the front part of the body.

While the fact that no new organ in a nascent condition has been found in any of the thousands of species of any living animal is precisely what all theories of special creation demand it is fatal to a theory of gradual evolution.

You remind me that you had explained incipient feathers as an adaptation to insuring warmth, a bird equivalent for a fur coat. It is as easy to imagine a fur coat accidentally possessing the power to lift its owner off the ground as to imagine a furry feathery down fortuitously developing into the intricate and co-ordinated structure necessary to lift a bird off the ground.

As to the alleged vestigial organs, a house-fly that hatched out devoid of wings would be a freak whether the event happened in Teddington or on a windswept island. If an individual of an insect species characterised by wings laid an egg that hatched out into a flea, I should say that that flea had been specially created, just as I would of a bird that emerged from an egg laid by a lizard. From

the fact that the primordium that gives rise to wings in most groups of insects gives rise to halteres or stumps in some groups, it does not follow that these are derived from winged ancestors. You seem to find it difficult to distinguish between your opinions and established facts. Thus you say there are 'many insignificant vestigial organs,' but you have not furnished any proof of the existence of any of them. Then you say 'a vestigial organ adapted to some minor use is nearly as good evidence for evolution as it would be if it were useless.' This is not so ; any structure of any use whatever is quite compatible with special creation. But I challenge you to name such an organ and state its present use, its early form and the different use to which it was put formerly and the stages by which it lost the latter and acquired the former ; and please state what caused this change of function.

You ask me to enlighten your ignorance and that of Dr. Julian Huxley and Messrs. H. G. and G. P. Wells as to the use of the semi-lunar fold of the human eye. In the human eye this fold acts as a scoop which picks up foreign particles that enter the eye, with the result that they become formed into a sticky mass in the corner of the eye where it causes neither irritation nor damage and can easily be removed by the finger. The moment a foreign particle gets on to the eyeball the eyelids close tightly and tears are shed and thus a kind of cistern is formed so that the front of the eye is freely bathed and the offending foreign matter floats in the tears. A special muscle sweeps both tears and foreign matter to the inner corner of the eye and, past the minute orifice of the lachrymal ducts which are raised by the flood of tears from the surface of the eyeball, to the concave membranous edge of the fold which scoops it up and passes it on to the *caruncula lachrimalis*—a small patch of modified skin covered with very fine hairs and provided with sebaceous glands which secrete a fatty substance that envelops the offending particle.[1]

As to the use of the human body hairs, let me here repeat what I wrote in the article 'The Man from Monkey Myth' which appeared in the *Nineteenth Century* for April 1944, and has since been reproduced in pamphlet form : 'Because human hairs neither keep man warm nor provide a mat to which young babies can cling, Darwin's followers imagine that they are useless structures. The learned authors of *The Science of Life*—H. G., G. P. Wells and

[1] See E. P. Stibbe's paper (*Jour. of Anatomy*, Vol. LXII, pp. 154–175. There is a drawing of the apparatus in Gray's *Anatomy* (9th ed., p. 591).

Julian Huxley—make the following pronouncement (p. 410): "The body hair of men and women is purely vestigial. It no longer serves to prevent us losing heat. And yet each of these tens of thousands of useless hairs possesses a useless muscle by means of which it can be quite uselessly raised." The truth is that these hairs have an important function. Each is embedded in a follicle into which opens the duct of at least one sebaceous gland secreting an oily fluid necessary to keep the skin in good condition. These hairs and the muscles attached to them—the arrectores pilorum—have a two-fold function. The muscles, which are situated on the side of the hair toward which it slopes, on contraction diminish the obliquity of the hair follicle and render the hair more erect, and, at the same time, compress the sebaceous glands and expel their contents (Cunningham, *Text Book of Anatomy* (1902), p. 733). The presence of the hair and its movements also prevent the mouth of the follicle from becoming blocked with sebaceous matter. Follicles that have lost their hair sometimes become blocked and this may result in the formation of a sebaceous cyst.

As to the 'goose flesh' effect, the erection of the hairs forces much of the oily contents of the connected sebaceous glands out on to the skin and so this thin layer of oil diminishes the loss of body heat by radiation.

You describe *The Science of Life* as 'that excellent book.' This may be so, if regarded as a piece of evolutionary propaganda, but I do not commend it as a scientific or a semi-scientific book. There are a number of reasons for mistrusting it, of which the most important is the authors' suppression of many facts against evolution. In places the authors do not think straight, and on one occasion they improved upon a quotation in inverted commas. As to the former point they follow J. B. S. Haldane in confusing the *fact* of natural selection which weeds out defective organisms with the *power* of natural selection to produce evolutionary changes. Thus Haldane cites in an article called 'Darwinism Today' the case of a wood in which white-trunked birches were almost entirely ousted by pines, with the result that the whitish moths that showed up against the pines were gradually exterminated. Only a Darwinist could believe that the fact that a well-camouflaged moth has more chance of surviving than a poorly-camouflaged one has any bearing on the power of natural selection to produce new types. At the end of the process which Haldane describes the dark moths are still dark, and the whitish moths, though fewer in number, are still whitish.

The authors of *The Science of Life* introduced into their book this story and touched up the Haldane quotation so that it looked a little more Darwinian : 'The assertion is still sometimes made that no one has seen natural selection at work *in the production of new characters.*' The words in italics are not in Haldane's statement. Lunn, who reviewed *The Science of Life* quoted this sentence and asked where were the new characters that had been produced, whereupon Haldane promptly demanded an apology from Lunn for making him say something silly, and Lunn had the pleasure of apologising to one Darwinist for having assumed that he had been correctly quoted by another Darwinian ! The whole story is told in the preface to the second edition of Lunn's *Flight from Reason* —a book which I commend to you—and as he justly observes, it would take a great deal of natural selection to turn Haldane's moths into an argument for Darwinism. In later editions of *The Science of Life* the offending interpolation has been omitted.

I have criticised *The Science of Life* only as regards its zoology. Others have done so in the case of the section on psychical phenomena, for G. N. M. Tyrell writes (*Science and Psychical Phenomena*, p. 150) : 'The authors omit references to practically all the serious evidence. . . . The reader of this chapter is left with no idea of what are the true facts of the case. . . . It is not science ; it is special pleading.'

I do not think that my criticism of Dr. Julian Huxley is less respectful than yours about Vialleton ; moreover I justify my criticism, and no one can say that of yours.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

Your last letter is more interesting and more puzzling than most. Your definition of a nascent organ as one which has never at any time and in any animal developed further is new and strange, also it seems to me pointless. So also is your contention that protozoa have nothing that can be called an organ. Some protozoa are very complicated, as for example Paramecium, or even Vorticella. I think these examples answer your question about nascent organs. The bristles of Paramecium and the organ of attachment of Vorticella can well be called nascent organs. These organs of protozoa have not developed further, as other creatures which have

similar but more complicated organs are probably not genetically related. The reason is probably that more complex protozoa would not survive in competition with the better equipped multicellular organisms.

Generally speaking, however, *any* organ is likely to develop when conditions are suitable, and when the further development has survival value. You are not asking for a nascent organ in the ordinary sense of the word, but for a *unique* nascent organ. Apart from these and other protozoa I know of none, and I know of no reason, evolutionary or otherwise, why any should exist. It is possible that they do, but it is immaterial. This seems to me to be another example of the fallacy which I have often found in your exposition—namely your delusion that there is any necessity for a species to change, or evolve further. Evolution is a well established scientific term which describes the changes which have taken place, not a metaphysical one implying that they must take place. Consequently in scientific work we describe the organs that exist, and try to trace their development, both embryological and phylogenetic ; but we must not infer that organs of which we know nothing ought to exist, which appears to be your contention. This argument of yours appears to me to be confusion of thought, pure and simple, and all your complicated explanations (evolutionary or otherwise) of the absence of what we have not discovered is entirely superfluous.

I am not satisfied with your explanation of the use of the human body hairs, although some anatomists would support you. I do not think this contention can be maintained. In the first place hairs are not necessary for the working of the sebaceous glands. In certain parts of the body where this oiling effect is really required we have the sebaceous glands, *but no hairs.* In the second place on the palm of the hand and on the soles of the feet there are neither, and I do not notice any greater tendency to dryness of the skin there than elsewhere. In fact I think the facts contradict you. I find that the back of the hand which has hairs and glands is more liable to get dry than the palm which has none.

Once again, about the goose flesh, I very much doubt your interpretation. Is the skin more oily after goose flesh ? I have never noticed it, and doubt it. My own view is that, so far as books on anatomy support you, this is a relic from pre-evolutionary times when it was thought to be necessary to find a use for everything. Sebaceous glands are necessary for the hair but the hair is not necessary for the sebaceous glands. So far as both remain on the

body they seem to me a vestige which is harmful rather than useful. Even on the hair of the head, people who are subject to scurf find the glands a nuisance, and the way they give rise to pimples and cysts is sometimes worse than a nuisance. I greatly doubt whether they serve any useful purpose, or, if there is any useful vestigial effect, whether it is not overbalanced by their harmful qualities. These organs appear to me to be useless, to a small degree harmful, but not sufficiently so to have been eliminated by natural selection. As a vestigial organ which has not yet been eliminated all this apparatus makes sense, but your suggestion that the hair is required to enable the sebaceous glands to oil the skin does not seem to me to be sound.

I need say very little further about the *Science of Life*. To speak of evolutionary propaganda in the present state of scientific knowledge and opinion is foolish. All except a very few of those competent to judge now accept evolution, and a book of this kind which did not explain why would be of very little use. My own criticism of the book is that I should prefer that part to be fuller. It is certainly not out of proportion to the rest of the book.

I have no wish to speak disrespectfully about Vialleton. I do not know what he has done to advance science (except write a text-book) and you have not told me; but I am willing to believe he has done something valuable, even though I do not know what it is. When I do not agree with him, in particular his contention that the family is the unit of creation (is this right?), of course I must say so. That he takes what appears to me to be an eccentric view is not a recommendation; but I have no desire to depreciate the few who support you (to some extent) more than is necessary.

All this is a side issue. So to a considerable extent is the question of the utility of vestigial organs. It is of course exceedingly difficult to prove that an organ is useless, and not very important. Probably some vestigial organs are useless and some are not, and it is not easy to draw the line. As you appear to agree that some are useless, as for example the second ovary of birds, and the second lung of snakes, mentioned in the last chapter, and some rudiments of the wings of insects mentioned in this, there is really no point in arguing about the usefulness or otherwise in doubtful cases. With regard to these I wish to make it quite clear that your explanation that these organs arise from the primordia in the embryo is no explanation at all. Of course they do. But why should these primordia be there if the organs are not needed? Once again here is a clear

proof of evolution. Otherwise you come back once again to the creation of lies or practical jokes.

I will conclude with a few more examples of vestigial organs :

1. Vestiges of hind limbs in some snakes, though not in all.

2. Vestiges of leaves in the butcher's broom and other plants where the normal function of leaves has been taken over by expanded stems.

3. Rudimentary stamens in such plants as Scrophularia (figwort).

4. The teeth under the skin in Platypus.

5. The few hairs on the muzzle of the whale.

6. The muscles for moving the human ear and the scalp, which are functional in a few abnormal people. Generally speaking, if time allowed, it would be very interesting to refer to Weidersheim who enumerated no less than 180 vestigial organs in the body of man. (S.410.)

I think this will do. As in other chapters it is not necessary to multiply examples. The whole animal world is full of organs which are important and functional in some species, but useless or converted to minor uses in allied species. Equally common is the morphological identity of organs with different uses as for example the stings of some insects with the ovipositors of others. Some vestigial organs are useless, others have different functions, in many cases the point is doubtful. It does not matter much. Whether useful or useless they show plain evidence of evolutionary change.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

As before when unable to meet my objections you describe them as incomprehensible or muddled, or confused. On this occasion you go one better ; they are 'confusion of thought, pure and simple.'

If the evolution theory be true almost every structure and organ in every multicellular animal must at one time have been what you describe as a *unique* nascent organ. Had we been present when some reptile was turning into a bird we should have seen on various parts of the body curious excrescences and wondered what they were. They would in fact be nascent feathers. Later these would assume what you might describe as the fur-coat stage of evolution ;

a little later we should see these structures growing very large on the forelimbs, and wonder what they were. So to-day we ought to see new organs developing, we ought to see clear evidence that many of the species around us are developing into something else. We should, in other words, see 'all nature in confusion' as Darwin admitted in the passage already quoted (p. 21).

Of what kind of organs do you imagine the 'bristles' of Paramecium and the organ of attachment of Vorticella to be the nascent state? As to vestigial organs once again you demonstrate the complete lack of objectivity in your controversial standards. When unable to explain a phenomenon in terms of evolution you complain loudly that it is unreasonable to dogmatise on ignorance, but you seem to expect me to give a perfectly satisfactory explanation of every alleged vestigial organ in terms of special creation. I have already said that the existence of vestigial structures is consistent with special creation (see page 223).

Here are my comments on the examples you now quote.

1. The hind limbs of some snakes assist them when climbing and hanging from trees.

2. Teeth in Platypus. I have already pointed out their use (see page 206).

3. Muscles that move the ears in man. These serve to stretch the epicranial aponeurosis, and provide facilities for the increased blood-supply to the external ear, thereby diminishing the risk of the ear getting frost-bitten. They also serve as a store-house for glycogen. Without some musculature in its structure the nutrition of the outer ear might be seriously impaired.

4. Bristles on the snout of the whale. What evidence have you that the whale descended from an ancestor of which the body was covered by hair? How do you know that these bristles are useless?

I am amused at your citing certain structures in plants as 'vestiges.' Do you believe that flowering plants recapitulate ancestral history in their embryonic development?

As to evolutionary propaganda, please tell me why practically every modern book on zoology sets forth only facts that do not appear to be against evolution and ignores all that appear to be against it?

In conclusion, whereas you make no pretence to offer any explanation of hit-or-miss phenomena, such as the transformation of fur-coat feathers into flight-producing feathers, I can offer an explanation of most of the structures which you describe as vestigial.

I note that your faith in evolution is such that rather than believe that man's body hairs are useful, you hold that these thousands of complicated structures, with the follicles that produce them and the muscles that work them, are not only quite useless but have persisted for thousands of years. Prodigious !

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I still think there is considerable confusion of thought in your interpretation of nascent organs. For example, in the early stage of the development of feathers, we could hardly be in doubt what the structures were. Obviously they would be divided scales. Nor is it true that most nascent organs would be unique. The sensitiveness to light of the anterior segment of the earthworm can well be described as a nascent organ, and I am not aware that it has developed to any considerable extent in any of the worms ; but it is certainly not unique. More elaborate organs of sight have developed independently in different phyla, but it is only the first of these (whichever it was) that could be described as unique. Poison organs have developed independently in insects, spiders, fish, reptiles and mammals (I think the skunk apparatus can be described as a poison organ), and even the throwing of the poison is found also in the spitting cobra. Similar needs give rise to similar structures but only the first can be described as unique. At the present time, when such a vast variety of organs have developed in the course of a thousand million years, it would be extraordinary if we could find anything absolutely new. Certainly it is not a reasonable argument against evolution that we have not done so.

How could the bristles of Paramecium develop ? There are many possibilities. They might develop into efficient swimming organs, or into poison tentacles. All sorts of things are possible. This, however, does not interest me. Evolution is something that *has* occurred and I am not interested to discuss what *might* occur.

The question of the utility of vestigial organs is a minor one. I am not prepared either to accept your dogmatic assertions about their uses, or even to dogmatise whether or no they are useful, or to what extent. This is a matter for future careful research. Anyhow it is not important. The existence of these vestiges is undoubted,

and is clearly explained by evolution. The only alternative explanation is the creation of lies or practical jokes.

I cannot make sense of your remarks about vestiges in plants. Most flowering plants have functional leaves. In a few species the functions of leaves are accomplished by stems, but the vestigial leaves are still there. The evolutionary explanation is that the plants in question are descended from normal plants with functional leaves. What has embryology to do with the matter?

The question of evolutionary propaganda arose out of your remarks about the *Science of Life*. As you now shift your ground to text-books on zoology, that criticism is now inapplicable. With regard to your further question why text-books 'ignore all that appear to be against it' (evolution) I can only say that, so far as I know they do not. At any rate you have had very considerable space to state those facts, and I do not yet know what they are. I cannot at the moment call to mind any of the facts you have mentioned, which you think are against evolution, which are not to be found in the appropriate text-book. You really should not make these general accusations. They are the sign of a bad case, and I do not think general accusations, which you have not substantiated in detail, help you in any way.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

If feathers evolved gradually, whether as the result of the fraying of reptilian scales or as new excrescences from the skin, they must have been in a nascent condition for a long period. In the earliest stages of their development they would not be recognisable as feathers, but later they would be before they were of use to keep their possessor warm or for flight. So with the spinnerets of spiders and other structures which we now see fully adapted to their purpose, and which, according to you, evolved from something else.

As I was a Magistrate and a Judge in India for many years and later practised at the English Bar I appreciate the importance of backing up accusations by evidence. My accusation that the case *against* evolution is virtually suppressed in modern text-books is easily decided. Please refer to what I have said about nascent organs in my first letter in this chapter. I shall in one of my letters on Man mention some suppressions of the discoveries of fossils.

How many of the books that assert that whales, sea-cows and bats are descended from quadruped ancestors, tell their readers that not a single fossil has been found of the Pro-Cetacea, Pro-Sirenia and Pro-Chiroptera which the evolution theory postulates?

You profess a great admiration for *The Science of Life*. You can discover for yourself how many of the facts and arguments in my letters are found in that book. It is for our readers, and not for you, to decide whether those facts and those arguments are suppressed because they do not deserve an answer or because they cannot be answered.

Perhaps you will quote it, if *The Science of Life* provides any adequate answer to Darwin's difficulty which you have twice evaded. We should expect, if evolution be true, to find 'all nature in confusion,' organs in every state of development from nascent organs to perfected structures. Why don't we?

As to Paramecium, if by 'bristles' you mean its cilia, these are already efficient swimming organs found in a large group of the Infusoria. If you mean its 'Trichocysts,' these are more efficient than poison tentacles would be because they can shoot out poison threads!

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

You truly say that in Paramecium, a unicellular organism, there are to be found a variety of adaptations, particularly, in a sense, swimming and poison organs. No doubt they are adapted to its very simple mode of life, otherwise the creature would not have survived. All the same they are crude compared with the organs of multicellular animals. They thus can well be described as nascent organs which have not developed further in this genetic series. I would remark also that, as so many such organs are found in the protozoa, it is not reasonable *now* to expect to find nascent organs which have not developed further in some species. I cannot see anything in this argument but confusion pure and simple.

With regard to the books dealing with evolution, you have again shifted your ground. You now say that *arguments* have been suppressed. You really cannot expect any book to trouble much about your arguments, except one like this, and that of Dr. Morley Davies, which are written for the purpose.

The suppression of relevant *facts* is another matter, and that you have no good ground for alleging, and weaken your case, such as it is, by so doing. The books on palaeontology, such as Zittel, are quite clear about what fossils have been found, and I do not think they exaggerate in any way. With regard to the disputed human skulls, the only recent book I know which deals with the matter fully enough to trouble with them, namely that of Sir Arthur Keith, discusses them at considerable length. I know nothing of this alleged suppression of facts and strongly disapprove of these vague accusations.

Yours sincerely,

H. S. SHELTON.

9

SOME INSTINCTS AND HABITS OF ANIMALS

DEAR SHELTON,

One of the many reasons why I reject evolution is the fact that thousands of animals have instincts and habits, which, in my view, cannot have evolved or developed gradually. Each of these is what Arnold Lunn aptly describes as 'a hit or miss phenomenon—an action that has to be got right the first time.'

As I have done much bird-watching I will begin by describing the nest-building of the Indian sunbird, and that of the common house-martin, because I have watched the construction of the nest of the former at all stages, and every one in England may easily watch the latter at work.

I may say, in parenthesis, that in my *More Difficulties of the Evolution Theory* I have said something about even more wonderful nesting habits—that of the Indian tailor-bird of making a nest by tacking leaves together, that of the oriole of slinging its nest to branches in the manner in which a hammock or shrimping-net is slung to its supporting frame, and that of the weaver-bird of constructing a hanging nest made of plaited grasses.

I maintain that the nest-building habit of the sunbird (Arachnecthra asiatica) cannot possibly have originated gradually, because the nest in an incipient condition, or, indeed, complete save for the finishing touches, would not only be useless as a nest, but a positive death-trap. *The nest of the first sunbird must have been almost as perfect as it is to-day.* In shape and size it resembles a pear, and pear-like it often hangs from the branch of a tree. More usually it is suspended from a branch of a bush. But the bird is catholic in her choice of sites. The nest is often suspended from a rafter in a verandah or a bungalow. I once saw a nest attached to the pendant of an electric light bulb, and another attached to a creeper some way down a well. As regards material for the nest, all is grist that comes to the mill of this little craftsman or rather craftswoman, for the hen alone builds : bits of grass, straw, bark, cocoons, lichen, hair, thorns, dried wood, and even scraps of paper and bits of rag. The materials used are not woven together ; they are attached to one another by

cobweb, and by means of this the nest is fastened to its support, possibly assisted by some other sticky substance. The nest has at one side an entrance hole, over which a little porch is constructed. While sitting on the eggs the hen often looks out through the entrance hole with her chin resting on the lower edge. Having chosen the point from which the nest will hang, the bird begins by winding some cobweb round this by means of her bill. Then she brings bits of dried grass, etc., to the cobweb to which they stick; then the attachment is strengthened by further applications of cobweb. Thus the nest is held together by cobweb. By the end of the first day the upper part of the nest has been formed. On the second day the skeleton outline of the whole nest is completed. During the three following days the exterior is strengthened and the egg-chamber is lined with silky cotton-seed or the like. When the nest is nearly complete the bird is at great pains to adapt the interior to the size of her body by repeatedly turning herself round inside. Usually two (rarely three) eggs are laid; thus, after the eggs are hatched, the nest has to support the weight of three or even four birds. I have never come across a nest unequal to the strain. Clearly a hanging nest such as this would be useless as a nursery until almost as complete and strong as it actually is. If you do not agree that the habit of making a nest of this kind must have originated *per saltum*, please show *any way* in which the habit of building can have arisen gradually, and describe a possible evolutionary series of nests leading from a scrape or hole in the ground to the sunbird's nest as it is to-day.

Here is Gilbert White's description of the process of constructing the nest of the common house-martin (*Natural History of Selborne*, letter XVI to Daines Barrington): 'The crust or shell of this nest seems to be formed of such dirt or loam as comes most conveniently to hand, and is tempered and wrought together with little bits of broken straws to render it tough and tenacious. As this bird often builds against a perpendicular wall without any projecting ridge under, it requires the utmost efforts to get the first foundation firmly fixed so that it may safely carry the superstructure. On this occasion the bird not only clings with its claws, but partly supports itself by strongly inclining its tail against the wall, making that a fulcrum: and thus steadied it works and plasters the materials into the face of the brick or stone. But then, that this work may not, while it is soft and green, pull itself down by its own weight, the provident architect has prudence and forbearance enough not to

advance her work too fast; but, by building only in the morning and by dedicating the rest of the day to food and amusement, gives it sufficient time to dry and harden. About half an inch seems to be a sufficient layer for a day. . . . By this method in about ten or twelve days is formed a hemispheric nest with a small aperture towards the top, strong, compact and warm: and perfectly fitted for all the purposes for which it is intended.'

A nest of this type, equally with that of a sunbird, would be a death-trap until sufficiently large and strong to hold and bear the weight of mother and chicks. If you think this habit can have been acquired gradually, the least you can do is to describe its growth either from the habit of building a nest of a different type or from no nest.

Needless to say that habits that cannot have originated gradually are not confined to birds. They are to be found in a great many different kinds of animals. The many books of Henri Fabre are filled with accounts of such habits in insects. I will not notice any here, but will notice the habits of the spider that lives in a diving bell of its own construction. The water-spider, which inhabits our pools and sluggish streams, is, like all spiders, an air-breather, but it builds under water a dwelling place in which the young are reared, and these, like the adults, breathe air. This home has the shape of a diving-bell: its walls are of silk, manufactured by the spider. It is moored to submerged leaves or to stones on the floor of a pool by silken threads which the spider spins. Before it can be inhabited it has to be filled with air brought to it by the spider. The body hairs of this creature are so constructed as to entangle bubbles of air; this applies particularly to the hairs of the abdomen which are long and hooked at the tip. Thus the spider when it goes underwater is enveloped in air, and this causes it to look as if clothed in silver, hence its name Argyroneta, the silvery-spinner. The lower part of the nest is connected with a surface weed by a strong silken cord, spun by the spider, along which it runs between its home and the surface. After the bell is completed the spider makes many journeys from it to the surface where it collects air which it takes below and liberates under the nest, so that this replaces the water there. This process continues until the water in the nest is all replaced by air, and then the habitation is ready for occupation, and the family is reared in it and kept as dry as if the nest had been above water. By the same process used-up air is taken to the surface and replaced by oxygenated air. I assert

that this habit cannot have been acquired by an ordinary land-spider by a gradual process of evolution. The ordinary spider cannot survive long under water. On being submerged it immediately curls up and is drowned if not rescued within a few minutes. Thus the spider could not have begun to operate under water until it had become fully adapted to this, and this adaptation would have been useless as such until nearly complete. And I find it difficult to see of what use it can have been above water while it was developing. Having acquired the adaptation, you presumably have to imagine that another set of haphazard variations caused the spider thus equipped to take to entering water. Even so your spider has a very long way to go before it constructed its nest under water. I cannot think of a habit half-way between that of rearing the young in the air above water and of rearing them in a receptacle under water. So far as I can see, the change of habit, if it occurred, must have been *per saltum*. Do you seriously suggest that this change of habit was the consequence of the accumulation of a number of haphazard variations, that had no effect on the habits of the spider until all terminated simultaneously at the point when one set of variations caused the spider to take to making a silken sheet of the proper size and shape impermeable to water, another set caused the spider to construct silken guy-ropes, a third set to attach the ends of these to stones or other objects under water, a fourth set caused the spider to crawl under the sheet and let loose air there, and to repeat the process until the sheet became a diving-bell, a fifth caused the spider to oxygenate the air in the bell when necessary, and a sixth set caused it to decide to change its old practice of rearing the young above water to that of rearing them in the bell? Do you suggest that this concatenation of hundreds of variations was such that it caused the spider to discard the mode of life of its ancestors and exchanged this *successfully* for quite a different mode of life? If these be not your views I am sure that our readers will welcome your exposition of them.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I must congratulate you this time on sending me a really good letter, in substance, form and tone. Up to the present I have found very little that you have said that appears to me to be even decently

plausible ; but this time you have stated problems that are beyond my power to answer to my own satisfaction. The instincts of animals, and particularly of insects and spiders, as a whole are certainly an unsolved problem. Moreover, to give even plausible suggestions as to the stages by which these instincts have arisen requires the knowledge of a specialist (or rather of a committee of specialists in different orders of animals), which, needless to say, I do not possess. I am not a specialist in the sections of natural history dealing with birds, insects and spiders, and consequently anything I may say on these matters, in addition to being speculative, must also be of a very amateur kind.

At the same time I think a few comments are allowable. The first is about your dogmatism. The whole world of science and of nature is full of unsolved problems. No progress at all would be possible if men of science were to adopt your attitude and say that because a problem was difficult and unsolved, even so much so that we cannot see the lines on which a solution is possible, therefore it is insoluble. Consequently to say that any of these instincts or methods based on instincts 'cannot have arisen gradually' is an unwarranted piece of dogmatism. Nor is it reasonable to speak of a nest 'in its incipient condition.' Obviously a nest at all stages, though it may vary in complexity, must have been good enough for the purpose, and any variation that may have occurred must be from some other form of nest which was reasonably well adapted to the same or to slightly different conditions. We do not know by what stages these instincts have developed, but I think it is a sufficient answer in some cases to say that they *must* have been modified from some previous condition.

One of your examples is that of the house-martin. A very short time ago there were no houses, no bricks, no convenient stones such as those which are found in stone houses, and no mortar, which makes a very convenient point of attachment. The pieces of broken straw, again, did not exist before human cultivation. What corresponds roughly to straw undoubtedly exists in nature, but it is different in character and texture. Clearly therefore the method of nest building *must* have been modified in comparatively recent times. Unless you are contending that the house-martin was specially created after the time when man began to build brick and stone buildings, you must admit that instinct and method are not fixed quantities given to the creature at its creation, but variable and subject to modification. It might throw some light on this

question if we knew whether this particular species builds nests elsewhere than in human buildings, and if so where and how. Possibly this is known, but I do not know it. Anyhow in this case there can be no doubt about the modification of the methods of nest building.

Once again I wish you to realise one other consequence of this non-possumus attitude. The instincts and methods of allied species, especially of birds, vary greatly. You must therefore here be contending for the special creation of each separate species. What therefore becomes of your friend Vialleton's contention that the unit of creation is the family? Your arguments are just as valid against him as they are against me. This indeterminateness of what was created puts you in the position of merely postulating special creation whenever you are in a difficulty. That is quite easy but somewhat futile. I will give you an example to show that this occurs to others beside yourself, and the light in which it appears to the working specialist who finds difficulties. The following is from Professor Hawkins recent presidential address to the geological society. (*Quarterly Journal Geological Society*, 1943.)

'The teleological doctrine of special creation affords the only easy explanation. However we have to realise that such a tenet affords no real explanation at all but is merely a restatement of the facts in an incomprehensible jargon.'

There are difficulties in many branches of natural history. When you find them you can if you like say special creation, but it really does not mean anything unless you reduce it to particulars. There is a sense in which special creation is intelligible, but in order for it to be so you must express it in some sort of exact and intelligible form. Unless you have some clear idea of what you mean, and some notion of what was created and when and where, it is not a scientific hypothesis, but merely, as Prof. Hawkins says, a piece of incomprehensible jargon. As an example of this confusion, in our discussion on geology, you found fault with my examples because you thought they did not go beyond the family. Now you contend for special creation of species and unknowingly acknowledge that my arguments were very relevant indeed.

Perhaps I had better say a few words about the water-spider, although I do not know enough about spiders to discuss them at any length. As a suggestion it is perhaps worth considering whether a previous form of the spider's nest may not have been attached to leaves, etc., on the surface of the water, and the power of the spider

to carry air for its own breathing might have arisen gradually in course of diving for prey or in escape from enemies. Alternatively, the nest might have been attached to the body of the spider, as indeed is the case with some land spiders. All sorts of suggestions are possible, but in any case they are pure guess-work, more indeed of a guessing competition than are the puzzles of morphology.

That is one more guess, and if I thought it worth while no doubt I could give a few more. I must acknowledge, however, that it is a valid point to make (though it proves too much) to point out that many instincts, especially of insects and spiders, are unexplained. The only remedy I can suggest is further study and research.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

Apparently in order to prevent your admission that I have stated problems which are beyond your power to answer to your own satisfaction being an anti-climax in this debate you make a number of assertions calculated to impart a little liveliness into this chapter.

You complain of my dogmatism because I named nesting habits of two birds, which 'in my view cannot have developed gradually,' and asked you, if you disagree, to show that I am wrong. Far from attempting this you say they '*must* (italics yours) have been modified from some previous condition.' Is not your assertion the more dogmatic? What you describe as my dogmatism I prefer to describe as my sceptical reaction to your dogmatism. My position is this: many instincts cannot have evolved gradually, and it is up to you to produce a plausible hypothesis as to how these hit-or-miss phenomena could have evolved gradually.

I have never asserted that, because a problem is very difficult and unsolved, it is insoluble. I do assert that you ought not to accept evolution until you can suggest a plausible hypothesis as to how the host of hit-and-miss phenomena can have evolved gradually.

As regards nests in an incipient condition you confuse the fact that every sunbird's nest in the earliest stages of its construction is in that condition with the problem of the inception of the habit of constructing a nest of the sunbird type and the difficulty of conceiving

of a series of completed nests starting from no nest and ending with a sunbird's nest.

You assert that 'the instincts and methods of allied species, especially of birds, vary greatly,' and that I 'must therefore be contending for the special creation of every species.' To this I reply that, as a general rule, to which there are many exceptions, the nesting instincts and habits of allied birds are very similar. All the 16 species of Indian sunbirds make the same kind of nest. All the kingfishers (there are 18 different species in India) nest in holes in banks dug by them: all the woodpeckers (there are 48 species in India) make nests by boring holes in trees, except Micropternus, which feeds largely on ants and bores its nest hole in an ants' nest attached to a tree. I have never contended that every species was specially created; I have told you plainly that for years I have been trying to discover the extent to which animals vary. I have never suggested that instincts are not variable. Indeed to my mind one of the greatest objections to all theories of evolution by the accumulation of fortuitous variations is the *adaptability* of most instinctive actions. Take the tailor-bird. The nest of this bird, depicted in the frontispiece to my *More Difficulties of the Evolution Theory*, is attached to only one pinna of a huge Stercula leaf. This is uncommon. Most often a whole leaf or two smaller ones are made use of, but there are records of nests in which three or four, and even as many as eight, leaves have been utilised. In each case the procedure is a little different. Do you seriously believe that the accumulation of fortuitous small variations can not only have taught the bird to build its nest, but to adapt its methods of work to different conditions? I most certainly do not. I put it to you that the theory that all things, including life itself, have developed out of salts in the sea is philosophically unsound, since you cannot get plus out of minus, or the mind of a Shakespeare or even the nest-building instinct of a sunbird, out of lifeless material. This instinct must have been implanted in this tiny bird by its Creator. It is you who assert that instinct can be accounted for by a purely natural process of evolution. That is your dogma. Now anybody who enunciates a dogma can fairly be challenged to show that that dogma does not involve absurdities. It is reasonable to ask you to produce a plausible theory to account for the phenomena in terms of your dogma. This you refuse to do.

You have hinted at what you think might be possible ways in which the spider's diving-bell might have originated. If however

you go into details you will soon find you are up against formidable difficulties. If this habit were the only one the evolutionist has to account for he might plead that an event against the happening of which the odds were billions to one had come off once, that the accumulations of fortuitous variations had accomplished this. But there are hundreds of these habits and the apparatus for carrying them out which you have to account for. It would seem that, except for the wheel, almost every mechanical device invented by man is used by some animals. Do you really believe that all these habits and utensils are the work of natural forces?

Nor is this the only difficulty you are up against. Speaking generally the most successful species, or, if you prefer, those of which the range is most extensive, are not those endowed with the most wonderful instincts. Take for example the toads. Most species take no care whatever of their eggs. The female lays them in clusters in water, and the male ejects his sperm over the cluster. No further notice is taken of these eggs.

Some species of toads however take great care of their eggs. One of these is the midwife toad (Alytes obstetricans). 'The male of the midwife toad,' writes E. L. Grant Watson (*More Enigmas of Natural History*, p. 7), 'seizes the female round the waist, after the usual manner of toads and frogs. With appropriate movements of his toes, he stimulates her to stretch out her legs, then places his own hind legs between them and bends up his knees at an angle, thus forming a kind of receptacle into which the eggs are laid. These eggs are yellow and are threaded together by sticky, elastic threads. Two to four layers of about ten eggs are laid. At the moment that the eggs are laid, the male shifts his hold on the female's waist to an embrace nearer to her head, and a little later stretches out his body in the act of fecundating the eggs. Again after a few minutes interval, he attaches the strings of eggs to his own legs, passing his feet through the egg-cocoon, and holding the gelatinous strings against his abdomen, so that the egg-mass bulges out round the posterior end of his body, he then retires to a safe retreat, where he hides during the day time. At night he comes out to feed, and on these nightly walks the eggs are dampened by the dew. After three weeks he takes to the water, still carrying the eggs with him. By this time the tadpoles have hatched: they bite their way through the envelope of jelly which has held them together. Not till the last of the tadpoles is free of the egg-strings does the father disentangle himself of what remains.'

Now the genus Bufo which takes no care of its eggs ranges over all the temperate and warm parts of the world except Madagascar and the Australasian area, while the midwife frog genus is confined to Western Europe. Nor is this all: fossils of Bufo have been found in Lower Oligocene rocks, showing on our agreed time-scale that the genus has been in existence for over 40 million years. If then this toad has lived all this time without taking any care of the eggs, why should the 'midwife' habit have arisen? Here is Joseph Needham's naïve reply (*Biochemistry and Morphogenesis* (1942), p. 33): 'In the course of time it was found that the protection of the eggs could best be carried out not merely by the continued presence of the parent organisms but by their actually carrying the eggs about with them. This is what happens in the case of the toad Alytes obstetricans.' This carrying of the eggs occurs in several species of toads, frogs and fishes. There is a toad found in Brazil which carries the eggs on its back and its skin grows round each egg so as to enclose it in a receptacle provided with a lid. Nor is this all, the male has a bladder-like pouch which projects, while the eggs are being laid, from the cloaca, and directs them backwards on to the female's back. Do you think that this habit together with the special apparatus needed developed gradually? In a considerable number of species of frogs and fishes the eggs are carried in the mouth of one or other of the parents until the young emerge. For example take the aft-topsail fish—Felichthys felis—found off the Atlantic coast of America. As the eggs are laid, over 50 in number, the male takes them into his mouth and carries them there 65 days until they hatch out and the young that emerge attain a length of about 3 inches. As it is difficult to see how the male can feed when carrying the eggs in his mouth, it would seem that he accumulates a reserve of tissue upon which he can feed while the mouth acts as a nest.

I am obliged to you for calling my attention to Professor Hawkins' assertion. This, like the oft-quoted pronouncement of D. M. S. Watson, goes far to explain the fact that so many people accept evolution in face of what seem to me to be a host of insuperable difficulties. You, Hawkins, Watson, Julian Huxley and many others are unable to see any plan or design in nature. Does it not occur to you that others may be justified in saying that they do see plan and design throughout nature? Does it not occur to you that you may be behaving like a colour-blind man who denies the existence of colour?

You complain that I say that in the present state of knowledge it

is impossible to know what the units of creation are, and that I postulate special creation whenever I am in difficulty. Well, there are a great many phenomena in the living world which neither you nor any one else can prove to be the result of the accumulation of fortuitous variations. This being so, to assert, as you do, that these phenomena *are* the result of fortuitous variations seems to me to be most unscientific, and is a proposition that ought to be challenged. I contend that, so far from the belief in special creation being unscientific, it is the *denial* of that possibility that is unscientific. G. Fano, remarking that 'the mind of many biologists is set, so that they will not tolerate the discussion of any force that is not physical or chemical,' truly observes that 'the immensity of our ignorance when compared with the very little that we know does not authorise such dogmatic obstinacy in us. It would be more scientific to assume a humbler attitude and be less assertive in our formulae.' (*Brain and Heart*, Eng. trans. (1926).)

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I have your last letter and find great difficulty in understanding it. I have said quite plainly that you have stated problems which are beyond my power to answer to my own satisfaction. That is quite easy. Anyone can do that about almost anything. Nor can I see anything dogmatic in saying that the house-martin could not have built nests in houses before there were any houses, and consequently it *must* have built them somewhere else. Still less am I unable to see that it is not allowable to assert evolution unless I can give a 'plausible hypothesis as to how these hit-or-miss phenomena can have evolved gradually.' I do not know how or where the house-martin built its nest before there were houses. On general principles I should surmise that the nests were of the same character, possibly built on cliffs or rocks, but that is a guess. I am not fond of guessing, and prefer to say that I do not know. It is something like the problem of what was the habitat of the clothes moth before there were any clothes. I should guess the furs of dead animals; but again it is only a guess. Incidentally it is only by an extended use of the term that a change of habit like this can be described as evolution, and I am inclined to regard this matter as beyond the scope of our discussion.

With regard to the manner of building of allied species of birds you say: 'as a general rule to which there are many exceptions the nesting instincts of allied species are very similar.' That is sufficient for my purpose. Unless you are contending for the special creation of species in the case of the many exceptions, the problem is yours as well as mine, and so irrelevant. Moreover, even when the nests are similar, there are considerable variations, and, if you think there is some well-defined limit to these variations, it is for you to say how and why.

You not only admit adaptability but assert it. 'Indeed to my mind one of the greatest objections to all theories of evolution by the accumulation of fortuitous variations is the adaptability of most instinctive actions.' But why? You are speaking here about birds. The adaptability is not nearly so great in insects. The bird has a brain—small compared with ours and even smaller than that of the average mammal of the same size—but still not altogether rudimentary. I see no reason whatever why it should not have some sort of intelligence sufficient to enable it to make minor variations in nest building. What is the difficulty?

I wish you would not drag in fortuitous variations and 'developed out of the salts of the sea' in sections where they do not properly belong. Fortuitous variations means nothing more nor less than variations of which the causes are unknown; we are not discussing the origin of life in a chapter on instincts; the mind of Shakespeare is equally irrelevant. I have no dogmas, or at least I have stated none. My contention is merely that the evidence for evolution is so overwhelming that any well-informed person not hopelessly prejudiced must accept it. I am not dealing with the causes, except that I may say a little in the last chapter if space allows. I really do not think it necessary to argue whether 'this instinct must have been implanted in this tiny bird by its Creator.' You seemingly intend it as an argument for special creation, but it is equally available for Deistic or Theistic evolution. Nor am I discussing whether or no there is design in nature. I have of course my own views on these speculative questions, but I shall not complicate the discussion by expounding them now. Anyhow they are speculative.

The only question which now concerns me is the common phylogenitic descent of the animal world, especially birds, spiders and insects. That these creatures have remarkable instincts is undoubtedly true. I understood that you were attempting to show that such instincts were incompatible with common phylogenetic

descent, and in particular that they could not have arisen by gradual modification. You have now however strongly asserted their adaptability, which is exactly my contention, and so the point, whatever it may have been, is lost. I always do my best to meet your objections, so far as I am able to understand them, but I fear in this matter our points of view are so different that mutual understanding is impossible. Certainly all through the book you have often failed to understand me, though I have done my best to be clear. Often, also, as here, I fail to understand exactly what it is you are trying to prove. When that is so, the best we can do is to pass on to the next section.

Yours sincerely,

H. S. SHELTON.

10

THE ORIGIN OF MAN

DEAR SHELTON,

Man is unique among living organisms. If we take his mental qualities into consideration we have to place him in a separate kingdom, as Geoffroy St. Hilaire did. If we consider only his anatomical characters it is an open question as to whether he should be placed among the Primates, because, as Prof. F. E. Parsons says : 'there is a greater gap between the musculature of man and that of the other Primates than there is between many different orders.' (*Ency. Brit.*, vol. 15, p. 990.)

The mental gap between man and the rest of the organic world is immense. As Max Müller puts it, one great difference 'consists in language as the outward manifestation of what the Greeks meant by *logos*.' (*Brit. Assn. Rep.* (1889).) Mivart pointed out that in all the accounts of evolutionists of the so-called origin of language the essential element of reason is 'quietly smuggled in as a matter of course.' He illustrates this by Darwin's suggestion that 'the wisest of the Pithecoids was able to *think* of a device for the information of his fellows.' Mivart's comment on this assertion by Darwin is : 'but it is just this first step which is ignored by those who desire lightly to span the gulf between brute and man.' (*Origin of the Human Reason*, p. 385.)

Nor is this all. To quote Thomas Dwight, Parkman Professor of Anatomy at Harvard (*Thoughts of a Catholic Anatomist* (1927)) :

'Not so strong of arm, not so swift of foot, without well-developed hairy hide, or large teeth, or strong claws, he (man) seems as a mere animal an exceedingly unfortunate one, very unfit for the struggle for existence in that imaginary period of half-fledgedness between brute and man.'

If we suppose that all these deficiencies overtook man after he had acquired his great brain, we are up against the difficulty that we have to suppose that all the men living suffered these losses simultaneously, otherwise those who suffered them would have been overcome by their better equipped fellows.

Another difficulty is that to-day we see a huge gap as regards

mental capacity between all races of man on the one hand, and the anthropoid apes and all other animals on the other. If the great brain had been acquired gradually, is it conceivable that none of the long line of intermediate individuals should have left descendants now living? This objection applies equally to the lack of present-day intermediates between every highly-specialised animal, such as a bat, a whale and a turtle, and its assumed generalised ancestors. As man, to quote Vialleton, is 'as far separated from his supposed simian relatives as bats and whales are from other animals' (*Membres et Ceintures*, p. 281), clearly the gradual evolution of man from a non-human ancestor is as impossible as that of a whale from a land mammal.

The fossils lend no support to this supposed evolution. They tell us that men and apes in the past were more diversified than they are to-day—a fact not in accord with evolutionism. They also tell us that in the past big-brained and small-brained men lived contemporaneously; that the skull capacity of a human fossil is no criterion of its antiquity. No one dares to point to any fossil and say of it that while not human it is of a species ancestral to modern man.

I am constrained to say that the fossil evidence has been so manipulated by evolutionists that the writings of the great majority of them do not give an unbiassed account of the facts. The fossils unfavourable to the evolution theory are almost universally ignored in modern books. One of these is the Calaveras skull found in 1866 in the U.S.A. in a deposit of Pliocene or possibly Miocene date. This seems to be the oldest known fossil of a man of modern type. But, with the honourable exception of Sir Arthur Keith's *The Antiquity of Man* (1925), the last book I have come across in which this fossil is mentioned is S. Laing's *Human Origins* (1892). This skull Keith (*op. cit.*, vol. 2, p. 471) calls 'the "bogey" which haunts the student of early man—repelling some, and fascinating some and taxing the powers of belief of every expert to breaking point.' The only reason for rejecting this fossil or rather its antiquity is that it does not fit in with the preconceptions of evolutionists! As Prof. Holmes put it (*Smithsonian Report*, 1899) to suppose that man can have remained unchanged through so vast a period is hardly less than admitting a miracle. Keith's comment on this assertion is (*op. cit.*, p. 473): 'It is equally difficult to believe that so many men should have been mistaken as to what they saw and found.'

The second fossil generally ignored consists of skeletal remains

of modern human type found in a Pliocene deposit at Castenedolo in Italy by Prof. Raggazoni in 1860. The well-known zoologist Sergi, who visited the site and saw the fossils and deposit, is satisfied that they are of Pliocene date. But, with the exception of Keith's book and Johnson's *The Bible and the Early History of Mankind* (1943), the latest book in which I have found mention of the Castenedolo fossils is Keane's *Ethnology* which appeared in 1901, although, as de Quatrefages and Keith, remark, but for the fact that these fossils do not fit in with the theories formed on the origin of man, no one would have dreamed of doubting them, much less rejecting them.

It is legitimate for transformists to disbelieve their antiquity, but it is not legitimate for writers to ignore them in their books, especially those written to instruct the public. The reason of this almost universal rejection by transformists of these early fossils is that their acceptance would destroy completely the claim of the much-vaunted Pithecanthropus fossils from Java and the Sinanthropus fossils from China which are paraded as possible ancestors of modern man, because these two fossils are of much later date than the Castenedolo and Calaveras fossils. In fact there are several more fossils of men of modern type of earlier date than Pithecanthropus and Sinanthropus, which are largely ignored. As I work inductively and not deductively and am not hampered by preconceptions, I accept the evidence of the rocks and realise that the known fossils tell us nothing whatever about the origin of man. Until such time as fossils of Pithecanthropus or Sinanthropus are found in Miocene deposits, I consider it pure waste of time to regard the creatures represented by the above fossils as possible ancestors of man. I look for ancestors of any animal in deposits laid down *before* those containing the earliest known fossils of the animal in question.

Quite apart from the fact that no mechanism is known capable of endowing an ordinary mammal with man's mental powers, there are morphological reasons that render the gradual evolution of man highly improbable.

It is impossible to explain by any existing theory of evolutionary mechanism, such as natural selection, the gradual transformation or evolution into a man of an animal having any of the characters which I shall cite; in other words no ancestor of man can have possessed any of these characters. These characters are:

(1) A hairy coat to which the young could cling, thus allowing the mother full use of all four limbs for locomotion.

(2) Quadrupedal gait.
(3) An opposable great toe.

Let us consider these. The passages that follow within inverted commas are from an article by me in *The Nineteenth Century and After* April, 1944) :

The Hairy Coat

'The main function of the body hair of apes and monkeys is to provide a kind of mat to which the young clings when carried by the mother, allowing her full use of all four limbs for brachiation or other form of locomotion. The young New World monkey hangs on to the back hair of the mother ; young Old World monkeys and apes cling to the hair of the mother's underparts. Le Vaillant records that he shot, in British Guiana, a monkey carrying a young one on its back. The youngster, which was not injured by the shot, continued to cling to its mother's dead body while this was being taken to the camp. In order to tear it away Le Vaillant had to get the help of a negro. When disentangled the young one made a dart for a peruke on a wooden block. It embraced the peruke with all four hands and could not be induced to quit it for four weeks.

'Now consider the case of a species of ape of which the body hair grew gradually shorter and finer. The shorter the hair became the more difficult it would be for the young to hang on and the greater would be the mortality resulting from them falling to the ground when the mother was moving fast ; and *ex hypothesi* Natural Selection would prevent the shortest-haired females rearing young, for, said Darwin (*Origin of Species*, p. 63) : "We may be sure that any variation in the least degree injurious would be rigidly destroyed." The only way in which the unfortunate species of which the body hair was becoming progressively shorter could avoid extinction would be for mothers to take to using one of their limbs to hold the young one. As this would allow only three limbs for locomotion, the mothers when fleeing from enemies would be sorely handicapped and so be eliminated by Natural Selection.'

Quadrupedal Gait

The supposition that man is descended from a quadrupedal ancestor is, I submit, unsustainable, man's upright posture and gait mark him off very sharply from all other types. Darwin did not

appreciate this. As he did not trouble to ascertain whether or not his imagined transformations were mechanically possible, the change from quadrupedal to bipedal gait presented no difficulty to him.

'He wrote (*Descent of Man*, p. 78): "We see . . . in existing monkeys a manner of progression between that of a quadruped and a biped." This is not so. Monkeys are quadrupedal, but, as they spend most of their time in trees, they are more agile, more supple than creatures which rarely leave the ground. Hence those who derive man from a quadruped naturally assert that this ancestor was a tree-dweller, be it ape, tarsier or lemur. They have to get man's ancestor up a tree. How it got there, how it became transformed from a ground- to a tree-dweller, they make no attempt to explain. Darwin starts off with an ape living in the trees and then makes it descend to the ground. Having got it back to *terra firma*, Darwin has to get it on its hind legs. Accordingly he writes (*op. cit.*, p. 76): "as it became less arboreal . . . its habitual manner of progression would have been modified; and thus it would have been rendered more strictly quadrupedal or bipedal. . . . Man alone became a biped; and we can, I think, partly see how he has come to assume his erect attitude. . . . Man could not have attained his present dominant position . . . without the use of his hands. . . . But the hands and arms could not have become perfect enough to have manufactured weapons or to have hurled stones, as long as they were habitually used for locomotion. . . . From these causes alone it would have been an advantage to man to become a biped. . . . To gain this advantage the feet have been rendered flat; and the great toe has been peculiarly modified, though this has entailed the almost complete loss of its power of prehension."

'What a picture Darwin draws of this prohominid, which, with commendable foresight and noble self-denial, abstains from using its fore-limbs for locomotion, and suffers agonies in its gallant efforts to balance itself and walk on its hind legs! How its spine, hip-, leg- and foot-bones, to say nothing of the great toes, must have ached while they were being reconditioned to adapt themselves to erect posture! Nor did these aches and pains entirely cease when, at last, the erect position was acquired. Dr. John Murphy solemnly assures us (*Primitive Man*, p. 76): "When the upright posture was new to the precursor of man, the necessity of frequent rests from it would be greatly felt."

'Even Natural Selection must have been moved to pity by the plight of this prohominid and so refrained from destroying it; otherwise, according to our evolutionists, man would never have come into being.[1]

'There is, as Vialleton puts it (*op. cit.*, p. 284), "absolute opposition between the attitude and the locomotion of man and those of the apes." No amount of wishful thinking or special pleading can dispose of this fact. He criticises a picture drawn by T. H. Huxley, showing a series of skeletons of anthropoid apes and man, all upright or almost so, differing only in size, the dimensions of the cranium and the arms, and a slight inclination of the spinal column. "This drawing," he writes (*Membres et Ceintures des Vertébrés tétrapodes*, p. 640), "which dissembles the contrast between anthropoids and man, has done much to impress on the minds of the incompetent the notion of perfect continuity between these two groups; it is one of the most striking examples of the schematism so often employed in support of transformist ideas." '

The Opposable Great Toe

'We have now to consider the supposed loss of the power of opposing the great toe. The corresponding toe of an ape may be compared to one of the blades of a pair of scissors, the other blade being represented by the remaining toes, these last being bound together by a band of fibres known as the transverse ligament. In man this ligament embraces the great toe as well as the other four, thus the human foot, as compared with that of the ape, is like a pair of scissors so tied that it cannot be opened. The hind limb of the ape is an efficient grasping organ, which the human foot is not.[2] Now, the transverse ligament must either embrace the great toe, or not embrace it; no intermediate condition is possible. If, then, man be derived from an animal having the great toe opposable, this non-opposability of his great toe must have arisen suddenly, *per saltum*, as a sport. As this would have imposed a great handicap in the struggle for existence, the Darwinist seems compelled to

[1] In addition to the handicap imposed by the change of gait, the incipient hominid would have suffered from the shortening and weakening of the arms. Baumann's dynanometer tests showed that a male chimpanzee is 4.4 times and a female chimpanzee 3.6 times as strong as a physically developed fit young man.

[2] In all anthropoid apes and a few monkeys the foot is a more efficient grasping organ than the hand. Hartmann, who objected to their feet being called hind hands, had to describe them as prehensile feet.

believe that after a definite date almost every individual had this disability, because, had only a few suffered from it, they would have been, in Darwin's words "rigidly destroyed." '

In other words, the blind forces of nature must have caused thousands of prohominids simultaneously to lose this opposability.

The theory of evolution is supposed to obviate the necessity for miracles. In fact it merely substitutes for the miracles of creation phantasies which even transformists compare to miracles. Indeed some of them speak of these phantasies as miracles, although apparently they do not deem them to be caused by supernatural agency. Thus W. Beebe writes (*The Bird*, p. 97) : 'The idea of miraculous change which is supposed to be the exclusive prerogative of fairy-tales, is a common phenomenon of evolution.'[1]

Here I must comment on Darwin's statement : 'With some savages, however, the foot has not altogether lost its prehensile power, as shown by their manner of climbing trees, and of using them (*sic*) in other ways.'

Notice the question-begging word 'lost.' Darwin here shows that his knowledge of anatomy was not profound. He did not appreciate the fundamental difference between the opposability of the big-toe in apes and in some humans.

'As Wood Jones points out, in *Man's Place among the Mammals*, "the human mobility of the big toe is effected by movement at the metatarsal-phalangeal joint, whereas in the monkey and ape the movement is largely at the saddle-shaped tarso-metatarsal joint." In less technical language, as the transverse ligament in man binds together the bones of the sole of the foot, the toes jointed on these are capable of a little independent movement varying in extent with the individual, just as the fingers of the hand are. In apes the big toe and the sole bone on which it is hinged can move at the joint with the ankle.'

Yours sincerely,

D. DEWAR.

[1] Professor J. Lefèvre writes (*Manuel Critique de Biologie* (1938), p. 35) : 'Grâce à Haeckel le transformisme est à son apogée. Il a repandu partout sa foi ; la parole ardente des maîtres entraine irrésistiblement les élèves. Dans leur leçons chargées de la mystique nouvelle, il n'est question que d'animaux se battant, s'allongeant, se ramassant, se tordant, se retournant, se pliant, redressant leurs bras, s'ornant d'appendices, se créant des organes, se fabriquant des tentacules et des yeux, se transformant les uns dans les autres se différenciant et se perfectionnant à volonté : prodiges plus merveilleux et beaucoup plus miraculeux que l'idée créatrice elle-même.'

APPENDIX

EVOLUTION THEORIES REGARDING THE ORIGIN OF MAN

CLASS I

MAN EVOLVED FROM A LEMUR-LIKE ANCESTOR

Group I

All races of men are derived from the same species of anthropoid ape (Monophyletic Origin).

(a) From an unknown kind of ape (Darwin).
(b) From a Dryopithecus-like ape (Haeckel).
(c) From a Sivapithecus-like ape (Pilgrim).
(d) From an Australopithecus-like ape (Broom).
(e) From a gorilloid ape (Morton, Schultz).
(f) From a brachiating ape (Keith, later view).

Group II

Different races of men are derived from different kinds of apes (Polyphyletic origin).

White man and chimpanzee derived from one kind of ape ; Negroes and gorillas from a second kind of ape ; Mongolians and orangs from a third kind of ape (Ardt, Kurz, Crookshank).

Group III

Man and anthropoid apes are derived from a common ancestor and are separate from all other Primates.

(a) From a Simian of later date than Propliopithecus (W. K. Gregory (later opinion), Elliot Smith (later view), Buxton).

(b) From Propliopithecus (W. K. Gregory (earlier view), Leakey).

(c) Man branched off from the Lemur stem before the appearance of Propliopithecus (Keith).

Group IV

Man descended from a Lemuroid without passing through an ape stage (Haacke).

CLASS II

MAN EVOLVED FROM A TARSIOID ANCESTOR

Group I

Man passed through an anthropoid stage (Elliot Smith (earlier view), Hooten).

Group II

Man did not pass through an anthropoid stage (Wood Jones).

CLASS III

Man evolved from a New World (Platyrhine) monkey (Hubrecht).

CLASS IV

Man evolved from a Prototarsioid (Le Gros Clark).

CLASS V

Man evolved from an upright ancestor early in the Tertiary Period (Osborn).

CLASS VI

The human stock branched off from the main Primate stock before the Lemurs and Tarsiers evolved.

This is Sera's theory. According to him the Order of Primates (from which he excludes Lemurs) is formed of six independent branches :

(1) represented by the Polynesians but by no anthropoid ape ;

(2) represented by the Mongols and the Orang ;

(3) represented by the Caucasians and the Persians but no anthropoids ;

(4) represented by the Europeans and the fossil ape Dryopithecus ;

(5) represented by Negroes, the chimpanzee and most gibbons ;

(6) represented by the Bushmen, the Andamanese, the gorilla and the syndactylous gibbons.

CLASS VII

Man branched off from the other Vertebrates as far back as Palaeozoic times ; the group to which he belongs had opposable thumbs and great toes. This group rose higher in the scale than all others because of its big brain. One branch of this stock gave rise to the Australian aborigines and bushmen, a second gave rise to Neanderthal man, the Negroes, the gorilla and the chimpanzee, a third branch gave birth to the Gibbons and Pithecanthropus, and the fourth developed into all the other types of man and the orang. This is Klaatsch's theory.

CLASS VIII

Man is derived from the most primitive mammal, and his line did not pass through a lemur- or tarsier- or anthropoid-stage. This is Westenhofer's theory.

CLASS IX

The six types of man cited by Sera above, each evolved independently of one another from different lumps of amorphous matter in the sea, which independently formed themselves into multicellular animals, each of which, by processes like those that occur in the development of embryos, followed by changes such as occur in larvae, eventually developed each into a different type of man. This is Sergi's theory.

DEAR DEWAR,

There is no doubt in one sense about the uniqueness of man. The question we have to discuss, however, is not the surface incredibility of his descent from other animals, but whether or no it has occurred. This is not to be decided by the casual thoughts of a Catholic anatomist, nor by the controversies of the last century between Darwin and Mivart, but by the evidence *taken as a whole.*

This I shall try to deal with in the present letter, and perhaps I may be allowed to reserve a few minor details till my next letter. I need not, for example, discuss your speculative objections to the evolution of a ground ape with bipedal gait, because, as I shall show later, Broom has proved that such an animal actually existed. Also I do not accept two of your fossil skulls as genuine, but instead of discussing that now I shall merely mention fossil forms that are universally accepted, and not trouble about those that are disputed. Nor shall I trouble about the exact line of descent of man from other primates, as it is first of all desirable to give evidence that man *has* so descended, although the details are not known.

What is the alternative? I think in this case there can be no doubt what it is. The anti-evolutionist in the category man must include all men now living or recently extinct, whether Veddahs, Australian and Tasmanian aborigines, pigmies, negroes, Chinese, or Europeans. These must be claimed as *one* special creation. I do not think you will dispute this, and it is important to emphasise it because some of the difficulties in tracing the descent of man from other primates are also found in the tracing of the genetic descent of the various types of men now living. We have therefore a fairly clear-cut issue. Man (by which is meant all men now living), is either ***one*** special creation, or, like the rest of living beings, a product of evolution, that is directly descended from other forms of life. Which is the correct answer to the problem?

On this point I must confess to a certain amount of sympathy with the prejudices of yourself and your fellow anti-evolutionists. The Christian Church in the past 80 years has adapted itself fairly well to organic evolution as a whole. Rome, for example, which in such matters is very cautious, but often more enlightened than other sects, allows full liberty on the general question of evolution, but is suspicious about the origin of man. There is no definite disciplinary decree, but Catholics are warned to walk warily. The doctrine of the Fall is somewhat fundamental, and is not easy to square with the gradual evolution of man from the lower animals. Moreover, theology apart, there is something a little derogatory to our ideas of human dignity in the suggestion that we and the apes are actual blood relations, even though separated by a million generations. There is, of course, another side, but I doubt whether even St. Francis, when he called the birds and the beasts his brothers, would have been altogether pleased if he had known that his statement was literally true.

One other general question needs to be mentioned. We keep theology out of our discussion as much as possible, but it is useless to attempt to conceal that the only reason any sensible man has for trying to find ingenious anti-evolutionary arguments is theological. Even there, so far as the general theory is concerned, there seems little point in it, but I must admit some point in the case of man. I wish to urge therefore that if there are any anti-evolutionary arguments worthy of notice, it is here that they should be brought forward. If a good scientific case cannot be made out for the special creation of man, it is not worth while to trouble about other alleged special creations. The whole anti-evolutionary case becomes not only obscurantist, but pointless.

I will grant you at the start that the faculties of man are important. No one can fail to be impressed by the difference between the mental powers of man and the apes. Even in the case of the average European, concerning whose mental capabilities I am at times inclined to be somewhat cynical, the difference is enormous, and when we consider the powers of a Beethoven, a Shakespeare, or a Newton, the contrast is unimaginable. I will however remark that I find it nearly as incredible that a human genius is a blood relation of the lowly Australian native, and of the still more lowly extinct Tasmanian, a genetic relationship on which both are agreed. How the change has come about, I do not know. I only know that it has taken place, and so we will proceed to the evidence.

First of all, to take the argument from morphology, man is a vertebrate and a mammal. He possesses hair, the female has mammary glands, and the young are produced in the normal mammalian manner. More than that, man is a Primate. He belongs to the same order as the great apes—the gorilla, the chimpanzee, the orang-outang—and has a similarity a little less striking to the gibbon. Whether you like to class him as a separate genus, family, or suborder, does not concern me. Personally, I think a separate family does full justice to the anatomical differences, but am not greatly interested in an academic discussion of this kind. I feel much the same as you do about the difference between Eohippus and Equus, and would merely remark that I consider the morphological differences between these two types greater than that between man and the apes.

What does require emphasis is the striking homology (or if you prefer it morphological resemblance) between man and the apes. With inconsiderable exceptions, every structure in the one can be

paralleled by a similar structure in the other—bone for bone, muscle for muscle, nerve for nerve. Even in the brain, in which the difference between man and the apes is most pronounced, every lobe and main suture in the one finds its counterpart in the other. In the brain, as in other organs, the differences are in size and proportions. The most important structures I know found in man but absent in the apes are an extra vertebra in the rudimentary tail and the muscle (peroneus tertius) raising the outer border of the foot. It will not take you much space to give a full list, if you think it worth while; they are of very little importance.

There are, of course, important anatomical differences of proportion in the adaptation of man to walking on the ground, instead of living in the trees. You can make a list of these also if you wish. Also, except on the head, the fur has disappeared, and become a useless rudiment of scattered hairs. Science and common sense indicate that there are important differences, which is why I agreed to classify man as a separate family.

Embryologically also man is a mammal and a primate. In view of the detailed discussion in the 7th chapter I need not deal with this in any detail. Embryology gives no support whatever to the suggestion that man is a special creation. Not only does the embryo show all the ordinary vertebrate traits, but it shows special similarity to the embryos of the apes. In particular, in primates only, including man, the 'formation of the embryo remains in abeyance until the membranes are developed' whereas 'in mammals generally the embryo is distinctly in process of formation before the double membranes grow up and envelop it.'[1]

In addition, the very young of man and the great apes are more similar than the adults. The human baby is less human. The anthropoid baby is less simian. As is well known, a very young baby has a pronounced grip, and can support its own weight. This power is quickly lost, but it does seem to refer to the ancestral history—to the period when the infant must grip tightly to the mother's fur, *or to some other object*, or die. Another similar interesting fact not so well known is that a newly-born infant, if put in warm water, will swim naturally, with a sort of dog paddle; indeed I doubt whether the Kanaka babies, whose parents continually frequent the warm seas, ever need to be taught to swim. This swimming power of the infant is also quickly lost.

Man is a museum of vestigial organs. We have already dis-

[1] *The Human Body*, by Sir Arthur Keith, p. 110.

cussed at sufficient length the body hair. Sir Arthur Keith mentions also a number of simian muscles, some present in all human beings, and some present in exceptional human beings only. Among those occasionally found are the levator clavicula (lifter of the collar bone), latissimo andyloidens (the apes' climbing muscle) and the palmaris longus, a tendon passing from the middle of the wrist into the palm. This tendon is well developed in the monkey, vestigial in the apes, and in man sometimes vestigial and sometimes absent. Numerous other vestiges are described in any good book on human anatomy. These facts illustrate the extraordinary morphological resemblance between man and other mammals, and particularly the apes, which is so detailed and so striking that only very cogent reasons on the other side can throw doubt on the obvious conclusion.

We must now consider human fossils and archaeology. The first point that emerges is the antiquity of man. We both of us need to trace the living races of man to a single source, and this in itself necessitates a vast antiquity. In later palaeolithic times skeletons of Cro-Magnon man have been found, tall, large-brained, possibly with Caucasian affinities. In caves a very little later are found statuettes, showing a somewhat Epsteinian representation of a race which appears to be very like the modern Bushmen, so even in palaeolithic times there were pronounced races of Homo sapiens. What was the original Homo sapiens like? How and when did the Caucasian and other white races, the negroes, the Bushmen, the pigmies, the Mongolians, the Tasmanian aborigines branch off? I do not know, nor I think do you; certainly we must go very far back into palaeolithic times. We should hear less of these truly genetic series if it were thoroughly understood that it is at present impossible to construct one for Homo sapiens.

The differences between the various races of man fade into insignificance beside the great variety of extinct man-like forms of which we have knowledge. When we go back (say) 50,000 years we have not only Homo sapiens but an entirely different species known as Homo neanderthalensis. This type had a large, but very flat brain, and peculiar teeth which differed from those of the apes even more than do our own. Whether it was a true physiological species we do not know; probably it was. Anyhow it has died out, and no trace of its enormous overhanging eye-ridges or peculiar teeth have been found in any modern race of man. Yet this peculiar type made fairly good flint implements (Mousterian) and buried its dead.

This raises a problem. Were these peculiar creatures men? Have we to look for a common ancestor for these and modern man? To the evolutionist, of course, it is obvious that there was a common ancestor, but how do the advocates of special creation regard this question? We shall probably have to go back to Pliocene times to find the common ancestor. The Lady of Lloyds, the Boskop skull of South Africa, and the type found in a cave in Galilee appear to be variants—similar though not identical—of this peculiar Homo Neanderthalensis.

A similar puzzle is found in the extraordinary massive jaw found at Heidelberg. The creature appears to have lived in the second interglacial. The jaw is simian, but the teeth are human, and some authorities think they resemble the Neanderthal teeth and so indicate relationship.

Neanderthal man is not our ancestor. He occurred too late in time; but quite recently, at Swanscombe, a skull has been found that is very modern in appearance. There are certain differences from modern man, in particular the jaw is slightly more simian and the skull thicker, but this specimen probably does not differ from modern man more than the Caucasian differs from the Australian. This skull is associated with Acheulean implements which, in Europe at any rate, always precede the Mousterian. Types very similar to modern man therefore both precede and succeed Neanderthal man in Europe. There appears to have been a struggle for survival, and we have survived.

The Piltdown skull discovered some time previously is also nearer to modern man than the Neanderthal, though much further from it than the Swanscombe skull. It is probably much earlier than the Swanscombe skull, and belongs to a race from which modern man may well have developed.

There is considerable difficulty about the dating. With the Swanscombe skull we are very fortunate in finding a type of implement which can be dated, relatively if not absolutely. With the Piltdown skull, and those I am about to describe, the dating is uncertain, both relatively and absolutely.

Two other species of Hominidae have been discovered in the east. The first is Pithecanthropus erectus. When it was first discovered it was doubtful whether it was an ape, a man, or even a monstrosity. One or two recent discoveries prove it to be a true species. The brain capacity is definitely intermediate between man and the ape. The thigh bone indicates that it was human in having

the erect posture. It has not been found associated with implements, but there is no reason to think it was incapable of making them. Of another extraordinary type, called Sinanthropus, several specimens have been found in a cave near Pekin. This is also human in being erect, and its brain capacity is very similar to that of Pithecanthropus. The two appear to be different species, but closely allied. Associated with Sinanthropus have been found primitive flint implements, which cannot be equated with any known European kind. There are also indications in the cave which show that fire was used. Both of these appear to be Pleistocene, and possibly not at the beginning of that period, so they can be regarded as survivals existing contemporaneously with more advanced types in Europe and Africa.

It should be added that the late Mr. Reid Moir for many years carried out researches in the red crag near Ipswich, and found crude implements which are now coming to be recognised as artificial. The cruder the implements, the more difficult it is to decide whether they are natural or artificial, but I think, so far at least as the later ones are concerned, he has proved his case. These deposits are certainly Pliocene, and implement-making creatures lived in that time, though no bones have as yet been discovered to tell us how nearly human the creatures were.

This is the story up to the present. The common ancestor of the present races of men is lost in the mists of palaeolithic time. Homo sapiens is the survivor of a number of species of man-like beings of which Homo neanderthalensis and Sinanthropus and possibly others also had sufficient intelligence to shape crude artificial flints. There were a number of species with brains greater than those of the apes, who were sufficiently human to walk erect, with all the anatomical peculiarities that this involves. Of these species, Piltdown man may well be our own ancestor, though this we cannot say with certainty.

Man has therefore lost his isolation. As the gorilla, the chimpanzee and the orang are different species of apes, so Heidelberg man, Piltdown man, Neanderthal man, Sinanthropus, Pithecanthropus, and Homo sapiens are all of the broadly human type, differing from the apes in erect posture and in quantity of brain. Somewhere in the remote past, probably somewhere about the beginning of the Pliocene, all these types meet. From the evolutionary point of view this is clear. These various types of Hominidae

wandered over the earth, but eventually, by slaughter or in other ways, Homo sapiens has displaced the others and inherited the earth.

It seems to me impossible to square these facts with the special creation of man. Which of these forms belong to the human creation? If you include Neanderthal man and the owner of the Heidelberg jaw, you must go back into the Pliocene to find a common ancestor. If you include Sinanthropus, there is no reason to exclude Pithecanthropus, as these types are not dissimilar. If you exclude both, then man-like forms with the erect posture, and sufficiently intelligent to chip flints and use fire, were apes. The problem of the faculties of man vanishes if you include them in the human creation, for no one will suppose that these lowly creatures had powers resembling those of modern men. An example of the confusion to which anti-evolutionists are liable in explaining these facts occurred in a discussion I had recently with Colonel Merson Davies, who is, I believe, with the exception of yourself, the only competent specialist in this country who advocates special creation. I asked him, if man was a special creation, which of these forms were men and which were apes. He replied that all were men except Pithecanthropus, which he called an ape. When, however, he had to print a reply, he abandoned this entirely. He thought it possible that the different breeds of dogs, like the lice in Exodus, were specially created. Inferentially (though he did not definitely say so) the same would apply to the Hominidae. He added that 'circumstantial evidence—indicating man's resemblance to the Trinity—is always more decisive than the details of bodily form.' (*Transactions Victoria Institute LXXI*, p. 141 seq.)

This sort of confusion, coming from a man who really is a competent geologist, does show how absurd in the light of modern knowledge is the contention that man is a special creation. I do not suppose that you would support Colonel Davies in all particulars, all the same it would interest me to know your opinion concerning which of these forms are men and which are apes.

Important recent discoveries take us a little further. In your last letter you expressed serious doubts whether an ape could acquire the erect stature and yet maintain its existence in competition with other forms. This doubt has now been solved. Quite recently Broom has found a number of curious fossils in South Africa, for the full account of which we shall have to wait a little longer. One of these he calls Plesianthropus, and the other Paranthropus robustus. The latter, which appears to be very like the

ground ape we have been searching for, has a brain of ape-like dimensions, only about 650 c.c. capacity, compared with 1,000 for Pithecanthropus and 1,300 to 1,500 for man. The skull was of a more human type than that of any other known anthropoid. Associated with the skull is a humerus very similar to that of man. We may therefore reasonably infer that the feet only were used for walking, and that the creature had assumed the erect posture.[1]

Broom thinks that the deposit in which the specimen was found is early Pleistocene, in which case it is too late to be the ancestor of man, and, like Pithecanthropus, must be regarded as a survival. We must wait for a fuller account before we can be sure of minor points like these. In any case these fossil forms are evidence of the existence of a number of creatures distantly related to man who were in brain ape-like but were also adapted for bipedal walking on the ground. Thus it appears that one of your many theoretical difficulties about what you think can or cannot happen is definitely answered because we have positive evidence that it actually has happened.

As in the other branches of Palaeontology, so in these relics of man-like forms, the links between man and the apes are not a truly genetic series in the sense that they are actual ancestors of man; but they are clearly genetic in that they must all be traced to a common ancestor. They break down the isolation of man. Anthropoid forms are much less likely to be found fossilised than are many other kinds of animals, and in view of this it is surprising how many have been found. Though the main stem has not been found, or if it has we do not know enough to identify it, sufficient branches are known to leave little doubt about the conclusion. The evidence of the fossils confirms that from morphology, embryology and vestigial structures. No theory of special creation will fit the facts. The known facts point clearly to the evolution of man from lower forms of life.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

You claim that the case must be decided on the evidence *taken as a whole*, but you reject the Castenedolo and Calaveras fossils,

[1] There are a number of notices of this discovery in the journal *Nature*, one of the earliest of which is November 19th., 1938.

which according to you ought not to have been in existence in the Pliocene period. May I ask if you reject on similar grounds the Kanam and Foxhall jaws, the Galley Hill and Clichy skeletons and the Wadjak skulls?

In my last letter I asserted, giving reasons, that man cannot have been derived from an ancestor having any of the following characters:

1. A hairy coat to which the young could cling.
2. Quadrupedal gait.
3. An opposable great toe.

Although your letter is a long one you have not attempted to controvert any of these assertions.

The 'serious doubts' I expressed were whether a quadruped could maintain itself in competition with other animals *while it was being gradually changed into a biped.* Once bipedalism had been fully acquired this handicap would cease, so that if Plesianthropus was erect, his erectness would not be a handicap. What you require to meet my argument are fossils of *transitional forms between bipeds and quadrupeds.* But was this ape bipedal? Is it not premature to assert this, seeing that we know nothing of its skeleton except an upper-arm bone?

I do not believe that many share your view that there is nearly as much difference between the mental capacity of a genius and that of an Australian aborigine. The latter, whatever his limitations, can talk, kindle fires and make tools. He has a language and worships God. Your whole case for the evolution of man is based on the illusion that similarities in structure necessarily denote blood-relationship. But these similarities between man and anthropoid ape are not nearly so great as you imagine. You have not listed them or the differences, but invite me to do so, as you did in the case of the differences between cats and civets. You seem to think that the creationist must, but the evolutionist need not, produce evidence! If these similarities were nearly as great as you imagine would such evolutionists as Wood Jones, Hubrecht, Osborn, Sera, Sergi, Klaatsch and Westenhofer have denied that man is a near relative of the anthropoid apes? Is their disbelief entirely without foundation? Here is one of the morphological reasons for this, as stated by Wood Jones (*Structure and Function as seen in the Foot* (1944), p. 16): 'That man in his evolution passed from a leg-longer-than-arm stage to an arm-longer-than-leg phase and then

back to his final and primitive leg-longer-than-arm state is a very unlikely phylogenetic story indeed.'

Here is an embryological reason for the disbelief in your theory of the origin of man : 'It was expected,' writes Keith (*The Human Body* (1912), p. 94) 'that the embryo would recapitulate the features of all its ancestors from the lowest to the highest forms in the animal kingdom. Now that the appearances of the embryo at all ages are known, the general feeling is one of disappointment : the human embryo at no stage is anthropoid in appearance.' Note Keith's 'disappointment' at this fact. His statement is clearly not the result of wishful thinking.

As you believe man to be descended from some kind of ape, you praise highly such a book as *The Science of Life*. In this production we read (p. 419) of a purely hypothetical creature thus described by its authors : 'Four-footed, tailed and hairy it took to the Eocene forests : it grew into lemur, into monkey, into ape : and finally ape turned into man-ape and man-ape grew to man.' This whole pedigree is purely a product of the imagination !

You reject the Castenedolo and other fossils because these do not fit your theory and you devote most of your letter to discussing such creatures as Pithecanthropus, Sinanthropus, Plesianthropus and Paranthropus, *all of which lived long after the earliest fossils of man of modern type were laid down*, and of none of which anything approaching a complete skeleton is known. Indeed, apart from the skull, jaw and teeth, we know nothing of the skeleton of any of the above, except what *may* be a thigh bone of Pithecanthropus and what *may* be the upper-arm bone of Plesianthropus !

This searching for missing links among comparatively recent fossils is what the French anthropologist Boule describes as Pithecanthropomorphism, the imaginative mythology of evolutionists !

The consequences of this vain search afford amusing reading. An imperfect molar tooth was found in a Pliocene deposit at Nebraska which Osborn identified as a tooth of an ape that had evolved a long way in the direction of man. This fossil he named Hesperopithecus, and Elliot Smith actually induced the editor of the *Illustrated London News* to print a full-page picture of Mr. and Mrs. Hesperopithecus. But, alas, the tooth, on closer examination, proved to be that of a kind of pig ! Another candidate for the missing-link club was the Java ape-man, Pithecanthropus, found by Dubois. Dubois, in order to secure its entry into the club, fooled the scientists for over twenty years by withholding from them the

fact that he had discovered in Java, not far from where he found Pithecanthropus, skulls of two very large-brained men !

Another candidate for the club that has had quite a good run is Sinanthropus, the Pekin Man. On page 32 of Mr. H. G. Wells' book *The Work, Wealth and Happiness of Mankind*, this creature is described as an ape-man just below the tool-using level. On page 53 we are informed that as the book was going to press 'Shaped tools well above the eolith level . . . have been found in close association with the Sinanthropus remains.' Within 20 pages Sinanthropus evolved from an ape-man into a skilled craftsman ! Now, the bones of Sinanthropus were found in a cave mixed with those of many kinds of animals : all these bones were much broken and gnawed as if by hyaenas. The limb bones have been broken by some instrument in order to get at the marrow, and the skulls of Sinanthropus have had holes bored in them in order to get at the brain. So the question arises : was Sinanthropus a cannibal who made tools and fires or was it the victim of a human being who preyed upon it ? The latter is quite likely as fossil bones of men of comparatively modern type have been found in China not far from those of Sinanthropus. Boule, writes ('Le Sinanthrope' in *L'Anthropologie* (1937), p. 21) : 'It seems to me rash to deem Sinanthropus the monarch of Choukoutien since he appears in the deposits in which he is found in the aspect of common game like the animals associated with him.' Few beings can have had more fuss made over them than Pithecanthropus. His discoverer, Dubois, had a picture made of him dressed up in the style of a 'masher' of those days. 'People,' wrote G. K. Chesterton, 'talked of Pithecanthropus as of Pitt or Fox or Napoleon. Popular histories published portraits of him like the portraits of Charles the First and George the Fourth. A detailed drawing was reproduced, carefully shaded, to show the very hairs of his head were all numbered. No uninformed person looking at its carefully-lined face would imagine for a moment that this was the portrait of a thigh-bone : of a few teeth and a fragment of a cranium.' Sinanthropus has not been lionised to this extent, but Black, Elliot Smith and Weidenreich have done their best for it. It, or rather the fragments of it which have been found, have been photographed more than some celebrities have. Of the twelve scraps of its jaws 81 photos have been published, the photo of each piece having been taken from several aspects.

In their zeal to demonstrate their simian ancestry few can refrain from making too much of every new fossil found. In the

words of H. H. Woollard (*Science Progress* (1938), p. 18): 'The notion of a gradual emergence of man . . . has exerted ever a seductive influence on the minds of anatomists, few of them being able to contemplate any other view consistently for long. This is shown very clearly by their behaviour whenever a new fossil has been discovered. The discoverer has been unable to resist the temptation of asserting that his fossil, if ape-like, presented all sorts of human characters, and, if human and clearly modern in character, that it possessed all sorts of simian characters, more or less hidden and elucidated only by minute examination.'

All this of course applies only to fossils that appear to support current theory. The fate of those which do not is thus described by E. A. Hooten: 'Heretical and non-conforming fossil men were banished to the limbo of dark museum cupboards, forgotten or even destroyed.' (*Apes, Men and Morons* (1938), p. 107.) The most heretical of these men are those of Castenedolo and Calaveras, and so you naturally disown them, for, in the words of Woollard, 'This discovery, that recent man has a vast antiquity, in fact greater than any other extinct variety, most anatomists have always tried to get round or minimise.' (*op. cit.*, p. 23.)

I note your assertion that some animals not only learned to talk but acquired language, yet you make no attempt whatever to show how this could come about. Nor have you even tried to meet the objections raised by Dwight. What you call his 'casual remarks' do not settle the question of man's origin nor do your *ipsedixits*, but the facts cited by Dwight are serious objections to your views, yet you have not met them. Far from taking the evidence *as a whole* you have ignored the greater part of it!

In conclusion your remark 'man is a museum of vestigial organs' will impress only those who have no specialist knowledge of the subject. To cite muscles as examples of vestiges is to disregard the fact that muscles are among the most variable structures. A number of small muscles occur in some men and not in others, and this is true of apes. When a given muscle is large in Jones and small in Smith, to call Smith's muscle vestigial is an abuse of language.

Monkeys, being better climbers than anthropoid apes, have more developed climbing muscles, but to speak of these muscles as vestigial in anthropoids and cite this as proof of evolution is to use a premise to prove a conclusion and then use the conclusion to prove the premise—a perfect example of 'confusion of thought, pure and simple!'

But *nascent structures* are your desperate need. If man be evolving his body should exhibit several of these. Not only does it not, but it shows very little power of adaptation to climatic extremes. If the evolution theory were true, the Eskimos should either have acquired a thick layer of subcutaneous blubber or have been as hairy as a musk-ox. The acquisition of a thick hair coat would have entailed merely a lengthening and thickening of man's thousands of body hairs. Facts such as these suggest that the evolution theory is just moonshine !

The words of Reinke spoken in 1902 are not out-of-date : 'The only statement, consistent with her dignity, that Science can make, is to say that she knows nothing about the origin of man.'

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

It is usual in this controversy for the second letter in a chapter to be an answer to the first. This time I did not follow the usual custom, and my reasons for not doing so have no doubt by now been communicated to you by the editor. In particular I said quite definitely that I intended to reserve 'a few minor details to my next letter.' Amongst these details are the disputed skulls. We will therefore discuss the skulls and skeletons first.

The great difficulty in deciding whether or no a skull belongs to the deposit in which it is found is that we do not know whether it is a burial. It may seem eccentric to bury a skull ; but as we know that existing tribes have curious customs about skulls it cannot be ruled out as too improbable. This is why the Castenedolo skull is almost universally rejected. In 1888, as you will find described in Sir Arthur Keith's book on the *Antiquity of Man*, a skeleton with a similar skull found in a similar position was undoubtedly a burial. Consequently reasonable caution demands that the previous discovery should not be accepted. The same objection applies to the Calaveras skull. In addition there is the further objection that the remains of ancient man are comparatively rare in America, so much so as to render it probable that he did not exist in that continent until a date considerably later than that in which he flourished in the Old World. Probability is the guide in all these matters, and the genuineness of these finds is exceedingly improbable.

Now let us consider probabilities. It is generally accepted that

Neanderthal man was displaced by modern man so abruptly that he can be marked out of the direct line of descent. The first thing therefore to decide is what sort of man made the Chellean and Acheulean implements. The recently discovered imperfect Swanscombe skull throws some light on this. As it is incomplete we cannot be too dogmatic. It is apparently very like that of modern man, but we must be cautious in being too definite. There is also a significant difference in the greater thickness of the skull bones. The date is almost certainly Acheulean. This discovery gives a greater probability to the genuineness of a number of other discoveries which Sir Arthur Keith has put in his 'suspense account.' In particular, though there are of course doubts, I am inclined to accept the Galley Hill skeleton. This shows an even greater significant difference in the thickness of the skull (10-12 mm.), that is nearly double the thickness of the modern skull. The lower jaw, also, according to Sir Arthur Keith, shows primitive features. I am inclined to regard this great thickness as indicating antiquity, and to accept the Galley Hill skeleton as representative of Chellean man. It appears that Neanderthal man was an interloper, and that both before and after him in Europe the dominant type was much nearer to modern man.

When did the ancestor of man cease to be sufficiently like him to be classed in genus Homo? No one knows with any certainty. Personally I am much inclined to the idea of putting Piltdown man very near the direct line of descent. The skull was found in a secondary deposit with remains of both Pliocene and Pleistocene fragments. The general view is to date the skull in the Pleistocene, in which case it probably represents a side branch. But why should it not be Pliocene? In that case it might well be ancestral to man, and the maker of the implements found by the late Mr. Reid Moir in the Pliocene crag. Of course this is merely a guess. Anyhow, however you may interpret this discovery, such a form does show *by its very existence* the great variety of the Hominidae, and inferentially that man is part of the animal world and descended from other primates.

Now a few words about man's more remote ancestors. You think he could not have had a hairy coat to which the young could cling. Most certainly he had a hairy coat. Hair is a dominant character of the class mammalia, and this is confirmed by the vestigial hairs on the body of modern man. Whether the young could cling to it is doubtful. We do not know when this particular

adaptation of the modern monkey arose. For all we know it may have been long after the human stem diverged. The same applies to the opposable big toe. This m[illegible] not have developed in the apes after man had branched off. I cannot understand your difficulty about the quadrupedal gait. That of the modern gorilla can hardly correctly be described as either bipedal or quadrupedal. It is intermediate. I see no reason whatever why the adaptations necessary to acquire a truly bipedal gait should not be acquired gradually by a forest animal which extended its hunting and food-gathering habits to the plains outside the forest.

I do not think it would serve a useful purpose to discuss your numerous quotations. The two skulls I have mentioned must almost certainly be rejected, and it makes very little difference whether the other doubtful ones are accepted or not. Beyond the very barest outlines no one knows the exact line of the descent of man, and it is of course easy to accentuate this doubt by collecting all the eccentric theories you can find, as you have done in the appendix to your first letter. Some of them are merely foolish, as for example Sera's theory and Crookshank's. What Crookshank has done to be quoted as an authority I do not know. But most of the theories vary round the general line laid down by Sir Arthur Keith, and personally I do not see much wrong with the diagram you will find on the frontispiece of his *Antiquity of Man*. Of course I should be inclined to alter a few minor details, such as the position of Eanthropus (Piltdown), but all this is guessing. I know of no facts against Keith's suggestion that the Hominidae and the apes branched off sometime in the Oligocene, and whether a little earlier or a little later does not matter. Broom's discoveries, when we have full particulars, will have to be correlated with all this. I note your opinion that the discovery of two ground apes is no proof of their descent from arboreal apes. Perhaps not. If you believe in special creation, I suppose a few special creations more or less hardly matter. All the same I should be interested to know your opinion on the question I asked in my last letter—which are men and which are apes? If you class such forms as Pithecanthropus and Sinanthropus as men, then you have admitted such a considerable degree of evolutionary change that we are entitled to assume the rest. If on the other hand you regard them as apes you are postulating a number of special creations of lies or practical jokes such as no reasonable person is likely to accept.

I think I have replied to most of the important points in your

two letters. If I have missed anything important, please tell me, and I will try again. Your letter contains so many quotations that it is a little difficult to disentangle the points that need a reply.

I am quite aware that the discovery that man is descended from other forms of life is a revolution in human thought. Nevertheless it is a conclusion which is for all practical purposes settled, and the modern world, including the religious organisations, must now try to adjust their ideas to this discovery, as they have at an earlier date to the Copernican theory of the Earth and Sun. It is their plain duty, and I trust they will do so thoroughly and without undue delay. In that connection it is as well to remark that modern man in the Pliocene, which you regard as proved, is almost as great a departure from traditional ideas. Certainly Hominidae did exist in the Pliocene, and there is little doubt that they were sufficiently intelligent to make crude implements, but the exact difference between their bodily form and that of modern man is not yet known.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

It is quite easy to discover whether or not any fossil is an intrusive burial. You cannot dig a hole in the ground and then fill it up again in such a way as not to reveal that this digging has occurred. The Castenedolo skull was unearthed by Prof. Ragazzoni, a professional zoologist, while searching for Pliocene shells, where dating is of great importance. Raggazoni took the greatest care to satisfy himself that the skull had not been buried by men; and other experts, including Sergi, who inspected the site were also satisfied on this point. Moreover the skull is not a complete one, nor were all the pieces found together, some pieces were found a little way from the main part of the skull. Further, some years later were found in the same stratum, about two paces away from the first find, numerous scattered fragments of the skeletons of two children. Here again the overlying stratum was intact. So to talk about intrusive burials is ridiculous.

The skeleton you mention that had been buried by man was in a different stratum, at a level three feet higher than that in which the earlier described fossils were found. The reason why so

many evolutionists reject the Castenedolo fossils is not because they might have been intrusive burials but because they do not fit in with preconceived theories.

The author of a book written for the public on the evolution of man is entitled to say that he rejects these fossils, but it is reprehensible to omit all mention of them when discussing the evidence of the fossils. This omission on the part of scores of biologists testifies to the truth of my statement that modern text-books habitually omit to mention facts unfavourable to the evolution theory.

You say 'the remains of ancient man are comparatively rare in America.' In fact they are rather numerous, but, owing to the influence of Hrdlicka, most of them are rejected. 'The extent,' writes Prof. Hooten (*Apes, Men and Morons* (1938), p. 51), 'to which prejudice enters into over-conservative estimates of the cultural or evolutionary span of man is well illustrated by the present controversy over the antiquity of man in the New World. . . . One of the most brilliant and progressive archaeologists said : "It would be a pity to have new evidence come to light which would overthrow all the admirable scientific work of the past indicating the recent arrival in the New World of the American-Indian." This man is one of the most indomitable assailants of the new evidences of man's early arrival in the New World. . . . It now begins to appear however that the personal heroism of one Dutch boy is likely to prove insufficient to stop the increasing trickles of fossil men through the geological defences. Dr. Hrdlicka is already forced to use not only one finger but all of his capable digits to plug the holes, but still they come.'

That Hooten is not exaggerating is shown by the following extracts from a paper on the Folsom culture (*An. Rep. Smith. Inst.* (1938), p. 531) : 'At several places in New Mexico and Colorado implements have been found in association with bones of extinct animals and in deposits suggestive of geological antiquity.' A find of man-made implements at Colorado associated with an extinct bison 'was received sceptically in most quarters, and in several instances there was a definitely hostile attitude toward suggestions that the discoveries might be of importance and worthy of further investigation.' (p. 533.)

These and other finds were examined on the spot by a committee of experts who reported that there was no question of their authenticity. 'One implement (a point) was still embedded in the matrix

between two bison ribs,' 'the associations could not be questioned nor explained away by any of the customary arguments against the authenticity of such an occurrence.' 'In spite of the convincing nature of the discovery most of the anthropologists continued to doubt the validity of the discovery.'[1]

You in 1945 not only doubt the authenticity of the Castenedolo skull but deny it, and devote several pages to discussing comparatively recent fossils as bearing on the origin of man!

'The gait of the modern gorilla,' you assert, 'can hardly be described as either bipedal or quadrupedal. It is intermediate.' I have dealt with this in *Man · A Special Creation* (p. 30). Here is a very recent pronouncement on this matter by Prof. E. Wood Jones (*Structure and Function as seen in the Foot* (1944), p. 13): 'The Gorilla . . . although it has taken to a partly terrestrial life has never succeeded in attaining to orthograde bipedal progression. No matter how much its admirers may praise its attempts at walking upright, the Gorilla remains a thoroughly quadrupedal mammal when walking on the ground.'

You ask for my opinion as to whether Pithecanthropus and Sinanthropus were apes or men. The proper time to ask for this will be after fossils have been discovered of their backbones, shoulder-blades, ribs, breast-bones, the long-bone of the fore- and hind-limbs and the bones of the wrist, ankle, hand and foot, i.e., when our knowledge of their skeletons is complete or almost so.

In reply to your 'special creation of lies or practical jokes,' let me remind you that your task in this controversy is to prove evolution, not to sneer at special creation. Having failed to perform your task you fall back on the argument from authority. Your views are old-fashioned. Forty years ago it might have been reasonable to dismiss anti-evolution with a sniff and a sneer, but the tide is turning against evolution, as is obvious from the catena of sceptical passages cited by Lunn in the Introduction. The authors of these represent but a fraction of the biologists who do not accept evolution. If you will refer to page 696 of Vialleton's *Membres et Ceintures des Vertébrés tétrapodes* (1924) you will find the following passage: 'Critics of evolution have multiplied to such an extent that it is impossible even to list them here. It must suffice in order to give some idea of them to refer to the short résumés given by Diamare

[1] Here are some figures of finds of ancient human remains in America, taken from N. C. Nelson's *The Antiquity of Man in America.* (*Ann. Rep. Smithson. Inst.* (1935).
Finds of Human Artefacts 89 (34 accompanied by animal fossils).
Finds of Human Fossils 54 (18 accompanied by animal fossils).

in *Studie Senesi*, vol. XXIX (1912) and Carazzi in *Il Dogma dell' Evoluzione* (1920).'

As a scientist I am not impressed by the appeal to authority. Long is the list of errors which at one time or another all but a small minority of scientists have supported. 'In my youth,' wrote Horace Walpole in 1774 (*Letters*, XIII, 172), 'philosophers were eager to ascribe every uncommon discovery to the deluge; now it is the fashion to solve every appearance by conflagrations. . . . I am a great sceptic about human reasonings; they predominate only for a time like other mortal fashions, and are so often exploded after the mode has passed that I hold them little serious though they call themselves wisdom. . . . How many have I lived to see established and confuted.'

And Walpole gives a long list of scientific problems of his own time, all of which have been quietly dropped since he died. Is it likely that the concept of evolution will not meet with the general fate of hasty generalisations?

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

Let us first deal with these fossil skulls. It is not as easy as you think to decide whether or no a disputed skull is a burial. When they are found accidentally, as usually happens, it may well be that the evidence of the disturbance of the ground has been destroyed beforehand. More important still, the evidence has sometimes entirely disappeared, that is the ground has been eroded down to the place of burial, and the fragments may or may not have been redistributed. A very good example of this difficulty is the Galley Hill skeleton. In that case the only evidence that it was a burial was the completeness and arrangement of the skeleton. There was no disturbance of the earth, and, as Sir Arthur Keith remarks, (*Antiquity of Man*, p. 185) 'as at Halling we must search for an old land surface' from which the burial took place. He comes to the conclusion that this is to be found in a stratum of gravel of Chellean age. The absence of disturbance of the ground proves only the antiquity of the burial. It does not prove that it was not a burial. In this particular case it makes very little difference. In the very improbable event of the skeleton not being a burial its date is thrown back to the Strepyan period. All the same there is a general agree-

ment that the skeleton was a burial and the only disputed point is whether it is of Chellean age or later.

It is this rigorous line of reasoning that I miss in the case of the two disputed skulls. The Italian one was found so long ago that such careful examination of all the possibilities was hardly to be expected. I know very little about the American skull, or about the date when man first appeared in America. The latter point is not important.

What does all this controversy amount to? What conclusion follows if the experts are wrong and these skulls are of Pliocene age? It really has very little to do with evolution, and the prejudice against them is not evolutionary. It makes very little difference if man very like modern man did exist in the Pliocene contemporaneously with a large number of other Hominidae. The other Hominidae are still there and give definite evidence for evolution. There is nothing very exceptional in a species remaining practically unchanged for two or three million years. Modern man (Homo sapiens) must then have developed earlier. It does not matter; there is plenty of time. It is not a question of the occurrence or otherwise of evolution. It is the minor conclusions of anthropology that are upset, and this is the reason for any prejudice against the so-called discoveries that may exist. While I wish to make it perfectly clear that I take the normal view of these skulls, and reject them entirely, I must emphasise that it really has very little to do with the subject of our discussion. Still less has the date at which man first appeared in America.

I have a little more to say about Man's vestigial organs. You appear to doubt their existence, and certainly you dispute their significance. First of all I have to return to a point which was discussed in a previous chapter (p. 228). Dr. T. W. Letchworth, the well-known ophthalmic surgeon, informs me that in his opinion, the third lid or caruncle of the eye, has no function whatever. Your suggestion that it acts as a scoop is, of course, somewhat difficult either to prove or disprove. In addition to this we have already discussed the body hairs. The tail also should not be forgotten, nor the embryonic wagging muscles, which afterwards disappear or are diverted to other uses. There appears to be no known function either for the pineal gland, or for the vermiform appendix. The organ of Jacobson is almost certainly vestigial, but this is not a good example because it is not easy to say what the original function really was. On the subject of the branchial clefts,

it should be noted that these sometimes give rise to pathological cysts which are thought to refer to the original organ in the fish. The pyramidalis muscle, which is exceedingly variable, and certainly useless as a separate muscle, is another good example. This refers back to the time before the placentals branched off from the marsupials. I think these are sufficient. It is therefore not necessary to look up the researches of Weidersheim (S.410) who listed no less than 180 organs which he regarded as vestigial. The existence of vestigial organs in man cannot reasonably be doubted, and, as was mentioned before, in which cases they are absolutely useless, and in which cases diverted to minor uses, is of very little importance.

I don't think I have mentioned special creation too often, and you certainly have mentioned it fairly frequently. As it is the only alternative to evolution that has ever been suggested, it does follow that, to the extent to which special creation is absurd, evolution must have occurred—even though there may be difficulties. And certainly it is you and not I who have used the argument from authority. If you will compare the number of your quotations on matters of opinion with mine I think you will find that obvious. Of course the overwhelming mass of scientific opinion is in favour of evolution, and there is no point in disguising that, but I think, so far as space allows, and so far as I have not been distracted by the necessity for dealing with your minor objections, I have given you plenty of positive arguments.

The general question of evolution, however, must be left to the next chapter. This chapter is concerned with man. It seems to me abundantly clear that all the lines of evidence, morphological, embryological, palaeontological, and these minor forms of evidence provided by vestigial organs all point with certainty to the conclusion that man belongs to the animal kingdom and that he cannot be regarded as an exception to the rule that all these forms of life have come into existence by evolution, that is by continuous modifications of pre-existing forms, which evolution dates back to the dawn of life on this planet.

Yours sincerely,

H. S. SHELTON.

DEAR SHELTON,

The reaction of evolutionists to the Galley Hill skeleton is evidence of their determination to distort facts in order to fit them into their preconceived theories. The point is, of course, that the

Galley Hill skeleton, which is very similar to that of modern man, has been found in a stratum (early Pleistocene) far older than those in which Sinanthropus and Pithecanthropus occur. As these creatures are supposed to be intermediate between man and his simian ancestors, it is most inconsiderate of Galley Hill man to make his appearance several thousand years before his alleged ancestors. It is incumbent on those who deem these creatures ancestors of man to show that the Galley Hill skeleton was not contemporary with the strata in which it was found. In consequence they assert that the Galley Hill man died on a much younger land surface, from which he was buried so that his body was placed in strata laid down in the early part of the Pleistocene, i.e., many years before he died. It is supposed that in course of time the younger strata became eroded away, so that their surface became level first with the upper part of the skeleton and then with the bottom of its grave, and this process was so contrived that the skeleton was not swept away, or destroyed by man, beast or anything else while the earth around it was being swept away or during the long time during which it lay exposed. After a time the surface on which the skeleton lay subsided and the course of the river changed so that it flowed over the skeleton, without washing it away, and eventually covered it with 8 feet of sand, gravel and loam. Thus was the skeleton preserved and all traces of its burial removed. The fantastic farrago of coincidence and improbability whereby the Galley Hill skeleton is extracted from the strata for which his passport has not been visaed by the evolutionists, is necessary because the only alternative is that man has undergone, as Keith remarks, 'only minor changes in structure for some 4,000 generations.' (*Antiquity of Man*, p. 265.) Several other human fossils have received similar treatment.

I do not think that Dr. Letchworth can have spoken of 'the third eye-lid or caruncle of the eye,' because these are not one and the same organ : the homologue in man of the third eyelid of birds and reptiles is the semi-lunar fold or plica semilumaris. This fold lies between the caruncula and the eyeball, and it is this and not the caruncula which is supposed to be vestigial. The view that this is a useless vestige presents difficulties. The third eyelid of birds and reptiles is a purely membranous structure, but the semilunar fold possesses between its two membranous layers a thin plate of cartilage, i.e., something lacking in the third eyelid of birds and reptiles. As you believe mammals to be descended from reptiles,

and since birds and reptiles get along quite well with their kind of third eyelid, please say what you imagine caused some reptile to change the nature of its third eyelid and to acquire this plate of cartilage, and how the change can have been effected *gradually* and without causing its possessor inconvenience. Do you suppose that all the changes necessary to convert a reptilian eye into a mammalian one took place at the same time as the drastic changes in the bones of the jaw and the skull? Changes which I asserted in my letter (p.164) could not have been effected gradually. In that letter I asked you, if you disagree, to 'describe stage by stage how these various changes can have taken place, the order in which they occurred, and how the organ of Corti can have started, and describe its gradual development into its present condition.' You have done none of these things. I invite you to do so now, also to describe how the eye of a reptile with its appurtenances can possibly have been gradually converted into the human eye. These are vital matters, because your whole case rests on your ability to show that I am mistaken in this matter.

You say the tail should not be forgotten, nor the embryonic wagging muscles. To this I add 'nor the embryonic postanal or tail gut.' Do you believe that the existence of this last means that man had an ancestor possessing a length of gut extending behind the vent into the tail?

The pyramidales muscles are not useless vestiges. They are the tensors of the linea alba, and when they are absent the lower part of the rectus muscles becomes proportionately increased in size.

There are a few structures in the body of man of which we do not know the use; but to assert that these have no use is tantamount to asserting that our knowledge of human anatomy and physiology is complete. I put it to you that such an assertion is, to say the best of it, premature.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I have referred to Dr. Letchworth again on the structure of the eye, and he tells me that he regards it as a doubtful point whether the caruncle properly belongs to the semi-lunar fold or to the conjunctiva. In any case it is an immaterial minor point. He has also pointed out that you have overlooked the very important fact

that the nictating lid is functional in a number of mammals, as for example the cat and the dog, and that in these animals the organ is supported by cartilage. Consequently your remarks on the structure in reptiles are wide of the mark. It would be an interesting evolutionary study to follow this up, and find out in which mammals the semi-lunar fold is functional and in which it is vestigial; but we are neither of us able to find definite information about this. It should be noted also that the existence of cartilage in the human vestigial organ, like so many other vestigial characters, is variable. It is often absent in white people, but much commoner in negroes. This and similar matters you will find set forth at length in Testut's book on anatomy, a book which is now to some extent out of date, but I think reliable on this point.[1]

I cannot now enter into a detailed discussion of the organ of Corti, or of vestigial organs in general. It is, however, necessary to dissent strongly from your statement that there is anything particularly vital in all this. The existence of vestigial organs in man, as in other animals, is excellent evolutionary evidence. But it matters very little when these organs are useless, and when they are diverted to minor uses. Nor is it material if it is sometimes difficult to explain the origin of some particular organ, whether vestigial or otherwise. The principal difference between us during the whole discussion has been in the assessment of the comparative value of the various types of evidence. You continually seem to me to magnify minor points out of all proportion to their real significance.

The same criticism applies to your treatment of the fossil Hominidae. You make a great deal too much of this Galley Hill skeleton. As I explained (p. 274) Sir Arthur Keith puts it in his 'suspense account,' and I personally am inclined to regard it as a genuine representative of Chellean man. In that case all your remarks about a burial are irrelevant. As I explained in my last letter, if it is not a burial it is Strepyan instead of Chellean, which is of no consequence whatever. The suggestion that the skeleton was a burial is based on the extreme improbability that a complete skeleton would be laid down in a gravel deposit. I should add also that it is by no means certain that, in the course of hundreds of thousands of years, any traces of disturbance of ground would remain. The percolation of water in a shallow deposit would undoubtedly affect the distribution of the earth. But, so far as this skeleton is concerned, it really does not matter.

[1] Traite d'Anatomie Humaine (Octave Dohn, 1894), Tome III, p. 116.

What it amounts to is that there are two sections of opinion about the evolutionary descent of man. The older one thought the change was comparatively rapid. The later one, represented by Sir Arthur Keith, thinks it comparatively slow. Both sections are 'evolutionists' (the term is now almost meaningless). Owing to the discovery of the Swanscombe skull, opinion is now coming round to Sir Arthur Keith's view. But it really does not concern you. When we have a minor dispute between two sets of people, both of whom are thoroughly convinced of the evolutionary descent of man, it makes very little difference to the fundamental weakness of your case which one is right.

To return to the main question, I had better state once again that the exact line of descent of man from other primates is not known. It is not definitely claimed that any of the fossil Hominidae are ancestral to modern man, and my suggestion that Piltdown man may be so is a speculation on which I lay very little stress. If that is what you are contending for it is admitted ; otherwise I see very little point in your remarks. The very existence of these forms, whether ancestral or side branches, is indubitable evidence of the evolutionary origin of man. There are many things unknown, and there is need for fuller investigation, but the fundamental fact of the origin of man from other primates seems to me to be thoroughly well established.

Yours sincerely,

H. S. SHELTON.

II

SUMMARY AND CONCLUSION

DEAR DEWAR,

It is now my duty to open this final chapter of general comments and summary. I have to gather together a few loose ends of thought which have been left a little ragged in the chapters on special aspects, and you have now an opportunity to expound those general aspects of design in nature, which you have brought forward previously, in my opinion in inappropriate places. All through the book there has been very little difference of opinion about the facts, and I wish to compliment you once again on your wide knowledge of the relevant facts. Our difference is in interpretation. You interpret the facts in an entirely different way from that of the scientific world as a whole. You are reopening a question which the scientific world is inclined to regard as closed. I have made it quite clear that I think it is closed, but all the same, as modern specialists are inclined to be a little too narrow in their outlook, I think there is something to be gained by a new discussion of main principles in the light of modern knowledge.

The difference between us is a little difficult to describe. You *see* things differently. There is very little in this world that cannot be interpreted in more than one way if we are so disposed. Moreover I do not think you quite realise how differently you do see things. All through the book, when you think you are putting forward scientific arguments, you have appeared to me merely to be expounding an unusual metaphysical attitude. As you were the first to mention the idea of the flat earth (or to be exact the editor in one of your letters) I will illustrate by showing where the analogy holds and what are the differences. You and these exponents are alike in seeing things differently from the ordinary man of science and I do not think you are entitled to be too annoyed at the comparison. It is not a point in your favour that you are so intolerant. My own point of view is much more tolerant, and, if the question is raised, my attitude is : well, if it comes to that, how *do* you know that the earth is round ? The question is not too easy to answer. Mr. Bernard Shaw relates the story of an occasion

when he took the chair at a meeting when the flat earth exponent wiped the floor with his amateur opponents, and he (Shaw) summed up by saying that, so far as could be discovered from the course of the discussion, the shape of the earth was cylindrical. I may mention in passing that several of the common arguments are distinctly unconvincing. In particular it is not a sound reason that you can go round the earth using either a magnetic compass or the angle of the Pole Star. The latter implies an unusual estimate of the distance of the stars, and the flat earth theory fails to explain why the Pole Star disappears at the Equator, but you have to go fairly deeply into the matter before you find the absurdity.

The difference between you is one of degree rather than of kind ; but *your* problem is much more complex. In the last resort we can bring the flat earth exponent up against definite measurements, though it takes careful analysis to do that well. In your case the facts lie in the remote past and this is not possible. Consequently you are worthy of a detailed discussion whereas they are not. Moreover, as there are unsound arguments for the rotundity of the earth, so there are unsound arguments for evolution, and you serve a useful purpose in pointing them out. It is well to examine the usual reasons for believing in evolution and to eliminate those that are unsound.

All the same the essence of the whole matter is not scientific reasoning but the way of seeing things, or, otherwise expressed, the groundwork of metaphysical assumptions. My own standpoint is well illustrated by that famous couplet of Pope :

'Remember Man 'the Universal Cause
Acts not by partial but by general laws.'

You wish to say that instincts are implanted in the animals by the Creator. Perhaps they were, but how ? You wish to emphasise that the animal and vegetable world was created. Perhaps it was, but how ? The intervention of Divine Creative Power is not to be found in crude and easy ways. You feel that there is design, and I am not inclined to argue about this, but all the same miracles, in the sense of exceptions to the ordinary working of nature, are not so cheap and common that because you find a fossil in the rocks, and cannot find any probable immediate ancestors, you are entitled to assume that it was specially created. That is the metaphysical difference that separates us. When we agree that we must not

assume the supernatural until we have exhausted natural causes, I mean it and you do not. After agreeing, you continually come back and tell me that this or that is consistent with special creation. Of course it is if you like to look at things that way. It is so much simpler. Mathematicians have been trying with only moderate success to work out under what conditions the matter of the planets can have been drawn out of the Sun. If you like to say the earth was specially created, you settle the question at once. The same applies to difficulties of evolutionary descent. Assume special creation, and the difficulties vanish. We do not know the exact stages by which the reptile changed to a bird. If you like to say the bird was specially created there is nothing to investigate. By what stages did the tailor bird reach its present method of nest building, or the water spider its method of rearing its young? No one knows, and we can only make guesses, and not very good guesses at that. If you like to say there were no stages, that these species were specially created with instincts complete, no one can prove you wrong. It is just the way you see things. The convincing value of evidence depends on the metaphysical assumptions you start with. Of course there are difficulties in the study of evolution, and it is quite easy to say they are insoluble. Indeed, in view of the complexity of the subject, I am surprised that the difficulties you have found are not more formidable than they have proved to be.

I fear that we have found great difficulty in understanding one another. Certainly all through the book my statements and arguments and your account of them have been very different things. You may possibly allege the same of me, that is for you to say. With regard to the way in which my statements seem to appeal to you, I will take one trivial example, and one important one of substance.

The trivial example is found in your letter (p. 245) in which you say: 'apparently in order to prevent your admission that I have stated problems beyond your power to answer to your own satisfaction from being an anti-climax,' etc. What is it all about? *Of course* you can state problems beyond my power to answer. Similarly when I have occasion to mention polyploidy in plants there is nothing desperate about it. It is a particular answer to a particular question. The important misunderstanding of substance refers to embryology. I must emphasise once again that I do not accept the recapitulation theory of the embryo. The embryo shows unmistakable indications of its ancestry, both immediate and

remote, but does not in my opinion recapitulate its ancestry. One consequence of this misunderstanding was that a very important point was not dealt with by you at all. You admit 'transformism' to an undefined extent. The important query therefore is : what happens to the embryo when the transformism you admit actually occurs ? Can the embryo be expected to give any indications of the units of creation—if they exist ? If not why not ? As you did not exercise your right to send a final letter in the chapter on embryology, you might find it convenient to deal with this point in your next letter. In a matter so complex as evolution the difficulty of mutual understanding is very great, and I think that both of us, and the reader, would do well to make due allowances.

I will now illustrate by one or two examples the useful purpose I think you serve by attacking evolution, namely to force us to re-examine the usual arguments, and to eliminate those that are unsound. The recapitulation theory of the embryo is one, and I will pay you the compliment to acknowledge that your previous writings have had some effect in bringing to my notice that it *is* unsound. Another important point is the utility or otherwise of vestigial organs. I think this is a point which calls for further detailed research. Because an organ is vestigial, and inconsiderable in size, we are perhaps a little prone to jump to the conclusion that it is useless. Another very important point that has emerged is that it is not sufficiently realised that the geological record (our record) is very incomplete. It is nearly as necessary to emphasise this now as it was in Darwin's time. Since then many fossils have been found which give valuable evidence for evolution. All the same there is no doubt that there still remain many gaps, even in the ancestry of recently evolved species, which we should like to fill up, and in the earlier evolution of palaeozoic times the record is mostly gaps. Fuller geological research is badly needed, and it is to be hoped that, when we settle down once more to the ways of peace, that further study will be given. We are also faced with the further question what part of the record is irretrievably lost in that it has been destroyed, and we have not as yet sufficient knowledge to estimate this at all accurately.

There is one other point which should be mentioned before I pass on to a brief summary of the evidence. We live in an age of specialists. Conclusions from scientific work are liable to be partial, and to receive publicity before they have been thoroughly examined in all their bearings. There is ample room for competent lay

criticism of the conclusions of specialists. Even in this question of evolution very unsound social inferences have sometimes been made. In particular an inaccurate appreciation of the meaning of 'survival of the fittest' has given rise to social doctrines which are very unacceptable. The gospel of ruthless force, which has done something to precipitate the present war, is only an extreme instance of similar fallacies which are found elsewhere. 'My view of your attitude is not that you are in principle wrong in criticising scientific conclusions, but that you are barking up the wrong tree. You are attacking the result of scientific investigation which, above all others, is thoroughly well founded both in science and in philosophy. In this particular case, theological prejudice, which I think you represent to some extent, has received support from a modern attitude of scepticism about everything in general. A generation ago it was fashionable at Oxford to talk anti-evolutionary nonsense, much as Communism is fashionable now, and the tutors smiled indulgently because it exercised the brains of the clever young fellows. I am inclined to think that some of these French scientists are very similar. In so complicated a subject as the evolution of the forms of life it is not difficult to find grounds for a kind of vague scepticism.

It now remains for me to try to summarise the positive evidence for evolution *as a fact*. A brief discussion of the causes I shall defer to my next letter. What are the grounds on which we can assert that the fact of evolution is thoroughly established, so much so that a very important section of people think further argument superfluous?

In the first place organisms are variable. I think we are agreed, for example, that dogs are one species, in spite of Col. Merson Davies' apparent disagreement. Also you abandon the breeding species as the unit of creation. You remark (p. 193) 'it does not follow that all the descendants of a single pair (*sic*) are for all time fertile *inter se*.' So far so good. In view of all the ink that has been spilt on the inability of experiment to produce new physiological species, this is very gratifying. But you think there is a limit somewhere. If it is neither the physiological species, nor the morphological genus (which is exceeded by the dogs) what can it be? Needless to say the evolutionary answer is that this limit does not exist. All species are variable. Why should there be a limit? Of course species sometimes fail to produce the variations necessary for survival and die out, but this is hardly relevant. Any change however great, even from an amoeba to an elephant, can in theory

be broken up into infinitesimal stages, and why is this not possible in nature? Of course at first sight it looks incredible, but so do many other well-founded conclusions of science. This admitted variability in all species is the first important fact.

The next point is the available time. The rate of change, even when comparatively rapid, is slow. The evolution of modern mammals from their primitive Eocene ancestors is an example of fairly rapid evolution, and that took about 60 million years. Still I think the 500 million years since the lower Cambrian are sufficient for all the changes that have to be postulated since then, especially as we must remember that rapidity of evolution should be measured not in years but in generations, and the generations become more frequent as the animals become simpler. Before the lower Cambrian there is a possibility of at least another 500 million years of simpler life. Graphite is found in the Archaean, and we know of no inorganic source for graphite. I believe you think there is some sort of time difficulty, but I have not been able to understand what it is. I think it will be generally agreed that the enormous period since the earth became habitable for life is sufficient.

As we have the necessary variability and the necessary time, we have now to consider the positive evidence that what is theoretically possible has actually occurred. Here I wish to emphasise most strongly that the evidence is the *total evidence*. It is not morphology, nor embryology, nor geology, nor vestigial organs, *it is the synthesis of them all*. Here is the principal point of difference between us. As an example in your letter (p. 51) you state that Huxley amongst others accepted evolution for unscientific reasons. Really this is a little amusing. What you mean is that Huxley accepted and advocated evolution although he frankly admitted at the time that the evidence from geology was practically non-existent. The certainty of a conclusion is relative, and the evidence for evolution is much stronger now that good geological evidence has been discovered. It is, however, your reasoning that is fallacious, not that of Huxley. Your fallacy consists in overweighting one type of evidence and ignoring the rest. It is quite allowable to come to a conclusion when one type of evidence is missing, if the other evidence is sufficiently strong. As an example, Tycho Brahe opposed the Copernican theory because he could not find any trace of annual parallax. We have found since then that the annual parallax of the nearest star is less than a second of arc, so of course he could not. But surely you are not going to tell us that Copernicus, Galileo and

Newton accepted the Copernican theory for unscientific reasons because this very important direct confirmation was missing, and the theory implied distances for the stars which must then have appeared hopelessly incredible. The evidence for such conclusions is the total evidence and no single type should be overweighted, much less should any type be ignored. Now what is this total evidence?

First there is morphology. We do not find all sorts of phyla in different geological periods appearing and disappearing, as might well happen if they were specially created. This is in accordance with evolution and no other explanation explains. All known fossils belong to existing phyla. Similarly the creatures living in different habitats—the land, the sea, the air, the depths of the ocean—are all related in the main features of their structure. Evolution explains. On the hypothesis of special creation I should expect the inhabitants of the depths of the ocean to belong to different phyla. The very mode of classification which has come down to us from pre-evolutionary times makes sense if we assume descent with modification, but it is a hopeless tangle on any other assumption. Why should man and the apes, the dog and the cat, be so like and yet so unlike. Evolution explains, I know of no other explanation.

On this subject of morphology you can and have raised difficulties—and they exist. I do not pretend that in every case I can solve them. The particular difficulties that are fashionable vary from time to time. But what they really amount to is always that it is not easy to imagine the stages by which some particular adaptation has arisen. Two that were fashionable in the old days were the eye and the lungs. But the difficulty of the eye is considerably reduced now we know the many stages found in species now living (S. 1022 seq.). And we now hear very little about the lungs since the existence of the lung fish has become generally known. You have made a great point of the vertical motion of the tail of the whale, and I think I have answered that reasonably well. I should like to add to my answer by showing how this difficulty tells against you. I am now a little handicapped by the closure of the Natural History Museum, so that I cannot look once more at the actual skeleton, but I think the picture you will find in the Cambridge Natural History sufficient. You will see that the vertebral column in the region of the tail twists round so that the dorsal processes become horizontal. This is an obvious *adaptation*. On any

ther hypothesis I should expect these structures to be in their roper place without twisting.

A still more obvious example is the seal. I cannot tell you in letail how the hind limbs acquired their present position, though think the structure of the sea lions throws some light on it. But he evolutionary evidence consists in the fact that the creature has ind limbs at all. The bones of the hind limbs—quite large hind imbs—extend backwards on either side of the tail, and further ack than the tail. What is the animal doing with hind limbs? Most other sea mammals have strong tail bones which accomplish he same purpose and the hind limbs are vestigial. You objected o the minute structure of the whale being called a pelvis, but urely you cannot but acknowledge that these bones of the seal are orrectly described as hind limbs. Here is an obvious adaptation; our very difficulties tell against you. This is evolutionary evidence hich leaps to the eye, and is convincing to all except those who re blind because they will not see. At the same time I wish to be ompletely honest and straightforward and will acknowledge that, hile some morphological difficulties are easily answered, and thers tell against you, it is always possible to bring forward others o which the solution is not clear. That is a small point in your avour, which should be given due weight, but not undue weight.

The second branch of evidence for evolution is geographical istribution, concerning which I have very little to add to what I aid in the appropriate chapter. It is, of course, much more limited han that from morphology. It is only in the case of distribution hich has occurred in recent geological epochs that the evidence is lear, because we then have a good idea where the forms in- abiting continental and oceanic islands came from. The absence f mammals on islands such as New Zealand, and of placentals in ustralia, is very important. On any other hypothesis but that of volution we should expect to find them there, as when they are ntroduced they flourish exceedingly. The forms that exist on the slands are similar to those on the mainland, but also different, and he degree of the difference corresponds fairly well with the time hich we have reason to think has elapsed since the island was part f or nearer the mainland. Your brief last letter in this section calls or some comment (p. 152). You say I have not challenged your ssertion that the distribution 'of amphibia fits the theory of reation better than that of evolution.' But I have. You also say: Wegener's theory is of course completely neutral.' That is where

you make the mistake. Distribution of modern mammals, and of other species which are recently evolved, is related to that of the nearest mainland. Here the evidence is clear. Distribution of amphibia, which are a very ancient class, is in a different category. If, as seems probable, this distribution occurred when the continents were gathered together in one mass, anything may happen, and such similarities as occur between South America and Australia, or South Africa, or even India, are naturally explained. Your difficulties vanish, or at least they cease to have any bearing on the main question of evolution. The distribution which has occurred in geologically recent times is clear evidence for evolution. The earlier geographical distribution (e.g., of amphibia) is confused and difficult, and cannot therefore be cited as evidence. But equally, it cannot be cited as evidence against evolution. Your difficulties become difficulties of detail, and have no bearing on the main question.

I have already dealt with one aspect of the evidence from embryology. We have now to consider the positive evidence it gives for evolution. This can be briefly stated in the assertion that the development of the embryo to the adult is indirect, and that it shows many indications of its ancestry, near and remote. I will first of all answer the question you asked me in in your letter p. 283. You ask if the post-anal gut means that man is descended from ancestors which had a gut extending into the tail. That is a possible interpretation, and in no way absurd, and is rendered even more probable by the fact that in primitive types such as the dog-fish the feature is more prominent than in mammals. But it is speculative, and so is not as a rule cited as evolutionary evidence. It is quite possible that the vertebrates arose from some worm-like form, and that this is an evolutionary relic, but it is not certain. I do, however, cite this as definite evidence against your assertion that the embryo develops directly to the adult, whatever qualifications you may like to make.

What, therefore, are the facts which *do* give plain evidence of ancestry? I must refer you to my first letter in the chapter on embryology (p. 154), and I do not think any additions are necessary. The development of three toes in the horse embryo is as good an example as any. If the embryo developed directly there would be only one toe. If on the other hand there is any metaphysical reason why the 'primordia' of the typical organism should develop even if not required in the adult, there should be five toes.

The development of the three toes is explained by evolutionary descent, and I know of no other explanation. I regard such features as the development of two lungs in snakes, and two ovaries and oviducts in birds, when the adult requires only one, as absolutely conclusive.

The evidence from vestigial organs also seems to me to need no further elaboration, and, as I have said before, I regard your remarks on nascent organs as merely confused thought. In the ordinary sense the whole world is full of nascent organs, that is of organs which are crude and undeveloped compared with similar organs in other species. That these are crude organs, and not entirely different organs, is powerful evidence of the genetic connection of widely different forms of life.

Finally we come to the evidence from palaeontology. I must first pay some attention to your last letter in the appropriate chapter (p. 136). It is necessary to emphasise once again that the evolutionary evidence consists of *the fossils that have been found.* Your statement about 'a further claim by you, viz., you may draw inferences from the absence of fossils' is entirely without foundation. I make no inferences from the absence of fossils, though I have tried to explain it. My whole contention is that *both sides* must be very careful what inferences they make from the absence of fossils. As an example, neither birds, mammals, nor even reptiles, are found in the Carboniferous coal measures. It is exceedingly improbable that any such existed, and the discovery of either birds or mammals would seriously upset evolutionary theory, but I should hesitate to assert that they did not exist merely on the ground that the fossils have not been found. My reason for certainty on this point is the whole structure of evolutionary theory, not merely the absence of certain fossils in certain strata.

A few more remarks are needed about your tables. With regard to most of them which deal with land mammals, I have nothing to add. In your reply you call my attention to your table on molluscs, and point out as an example that 64 genera have been found in the Jurassic. What about it? A few good fossiliferous rocks representing only a million out of the 50 million years of the Jurassic could easily give that number, and the evidence for evolution in the Jurassic would be negligible. Of course, the Jurassic is not so arranged, but so far as your evidence is concerned it well might be. But the finding of fossils of primary and secondary creatures is exceedingly erratic, and shows clearly the fragmentary nature of

the record. Here is one more example taken from Prof. Hawkins' address previously mentioned. 'Paleodiscus is known by some dozens of specimens from a diminutive quarry in the Lower Ludlow flag—*but nowhere else.*' Does this not illustrate what I have been telling you all the time—that fossils are lucky finds, and only represent fragments of the vast abundance of life that has existed for perhaps a thousand million years.' I think I can infer from this absence of fossils the fragmentary nature of the record, but I don't infer anything about the genetic relationship of paleodiscus.

There is one other type of evidence which should be mentioned here because it belongs both to geology and to embryology, and so is likely to be overlooked in both sections. I will give two quotations from Zittel's *Introduction*: 'The Palaeozoic Bellinuridae found their counterpart in the larvas of the common Limulus,' and 'fossil crinoids resemble the young of the living genus Antedon.' Thus palaeontology and embryology interlock to give powerful evolutionary evidence. Why should there be these remarkable similarities except on the ground of genetic relationship?

I have been trying all along to grant you such minor points as are in your favour, and so it is as well to say that the absence of *recognisable* fossils in pre-Cambrian rocks is one of them. The discovery of some record previous to that of the Lower Cambrian would be exceedingly welcome. This, of course, is merely an instance of the fragmentary nature of the fossil record, but it is a very striking one. I must, however, emphasise once again that, while in most cases there is plain evidence of the lapse of time between the Cambrian and these earlier rocks (especially where traces of life have been found), there is no evidence whatever of continuity of deposition in Cambrian and Pre-Cambrian anywhere, nor is such evidence possible in the present state of our knowledge. The absence of recognisable pre-Cambrian fossils is a minor point in your favour, but it is not permissible to exaggerate.

With regard to the evidence from geology as a whole, that is the evidence from the fossils that have been found, I do not think I need add anything to what I have given in the appropriate chapter. Of course, there is much more. One friend has remarked that I might have made more of the Ammonites. I might. But I have only given illustrative examples, and I think they are sufficient. It is not in dispute that much evidence we should like to have is missing. This, of course, is because of the fragmentary nature of the record, which has been sufficiently discussed. The important

point to emphasise once more is that all this must be regarded as *confirmation*. It is not part of the original evidence on which evolution was accepted by the scientific world in the time of Darwin and his contemporaries. There was then no palaeontological evidence of any importance. Now there is a considerable volume of it, and it is slowly increasing in every decade. It is like the discovery of annual parallax, which did not take place till the time of Bessel in 1834. And the present position when only some of the ancestral forms of living beings have been discovered is very like the present position in astronomy when only some of the stars are near enough to have a measurable parallax. The evidence for evolution is good enough without the geological support, just as that for the Copernican theory was good enough before the discovery of annual parallax. But the geological evidence has been found, which for confirmation is more than ample.

Needless to say, we expect much more to be discovered. How much can be discovered, and how much is lost because it has been irretrievably destroyed, is an open question which is much too speculative to deal with here. The position at present is that much positive evidence has been discovered, and that all that has been discovered, though it does not always give positive evidence, fits well into the general scheme. Some evidence, like the discovery of Archaeopteryx, is so plain that it is convincing to all who approach the matter with common sense and an open mind. If anyone says, as you appear to do, that they will not accept evolution until a great many more gaps have been filled, there is no more to be said. I think the common sense of the majority will decide against you.

In conclusion, I must emphasise once more that the evidence for evolution is the *total evidence*. It is not allowable to take one section and magnify it at the expense of the rest. When Morphology, Embryology and Palaeontology all point in the same direction, when all this is supported by the facts of geographical distribution, and by the peculiarities of vestigial organs, when no evidence of any kind which can be called definitely adverse is found anywhere, and when the best an opponent can say is that much desirable palaeontological evidence is missing, or that there are a number of morphological difficulties to which no good answer has been given, the conclusion is proved as well as is possible in a matter so complex. Also, as the question is so complex, it is possible for anyone to say, as you do, that he will interpret all this in another way. When all

is said, the general metaphysical outlook of the individual is the ultimate factor in decision. In this case, unlike the Copernican theory, there are no definite quantitative measurements which can be brought up against you. It is only relatively and in the mass that you can be brought up against absurdities. All I can hope to do is to show that to the ordinary person who reasons in the ordinary way the evidence for evolution is so strong as to leave no reasonable doubt. If you like to reason in an extraordinary way, and to express unreasonable doubts, there is very little to be said. The evidence is all indirect, it is to be found in many branches of science, and it needs careful co-ordination to appreciate it in all its bearings. It is the only known reasonable and probable explanation of the facts of life.

Yours sincerely,

H. S. SHELTON.

APPENDIX (On Cats and Civets)

The question of the exact degree of difference between Equus and Eohippus. and its relation to the normal differences which separate animals of allied families, as for example cats and civets, needs clearing up. Personally I have little doubt that I have proved my case ; but the discussion has been a little confused, and so a final summary is desirable here. I put it in an appendix because to me it is a minor point and hardly worth discussing. Nor do I wish to bore readers who are already satisfied that my case is proved. My reason for troubling with it at all is that it is much more important to you and to the editor than it is to me.

This question was first raised, in my opinion very inappropriately, in the first chapter. In your letter (p. 51) there is the following passage, strongly emphasised by being put in italics : 'I challenge you to cite a genetic series of fossils linking by small steps an order with another order, or a family with another family. You have but to show such a series in order to convert Lunn to evolutionism, and to make me reconsider my attitude towards it.'

The first obvious comment is that, as it would naturally be supposed that you and the editor know what the geological record will and will not do, it is a somewhat cheap method of controversy to challenge me to produce evidence a little more complete than that which you think actually exists, and usually such a method can well be ignored as a rhetorical device. Unfortunately for your

'challenge,' however, you had forgotten what family and order meant, and were obsessed by the elementary fallacy of regarding them as representing fixed instead of variable values. Therefore, as you persisted, and (again in italics) repeated the same remark on p. 56, I replied in the following words: 'As you are so persistent, I will say at once that the change from Equus to Eohippus can be traced by small steps, and the change is *considerably greater than* that usually implied by linking a family with another family.'

It was of course open to you to say that this was not what you meant, and that you were not asking for evidence that exists, but for evidence that you knew did not exist (though it well may exist in the future with further discoveries). You did not, however, take this line and so we agreed (1) That the change from Equus to Eohippus could be traced by small steps. (2) That the cats and civets were a fair example of different allied families. It therefore followed that if I could prove that the difference between Equus and Eohippus was as great as (it is actually considerably greater) that between cats and civets, I should meet your 'challenge.'

The discussion continued in the chapter on geology, but instead of meeting the point directly you argued about mountains and mice, which of us ought to give the differences between cats and civets, whether the differences could best be assessed by numbering them, and whether I ought to allot some of my space to you at a time when you were better off for space than I was. Therefore, to bring the discussion back again to actuality, I will now repeat the differences between cats and civets on the one hand, and Equus and Eohippus on the other.

The differences between cats and civets are mostly those of soft parts, and so irrelevant, as they cannot be used in the comparison. With regard to the skeletal differences, I think it will be generally agreed that those given in the *Cambridge Natural History* are sufficient. Anything not given in so full a treatment of vertebrate anatomy can be regarded as minor differences such as could be found in different species of the same genus. If you include those you might make up a portentous list. It is possible to tell whether a single bone belongs to Homo sapiens or Homo neanderthalensis, notwithstanding the fact that both are universally classified in the same genus. We must therefore only consider the major differences which distinguish families and orders, not the minor differences which distinguish species. These, as listed in the *Cambridge Natural History* are as follows:

1. In the Felidae the auditory bulla is inflated, there is an internal septum, the paraoccipital processes are flattened against the bullae, there is no alisphenoid canal. All these distinguish the Felidae from the Viverridae, except that in the Viverridae the alisphenoid canal is *sometimes* present.

2. The head and body of the civets are more elongated than in the cats.

These two are the *important* differences which separate *all* cats from *all* civets. You can of course make these up to any number you like by going into further detail, and by saying the same thing twice over, as for example if the head and body are more elongated it naturally follows that the legs are relatively shorter; but this is all that really matters.

It happens, however, that the civets vary considerably among themselves. They have several sub-families. In short they may be described as a rag bag of creatures which have changed from the primitive carnivora less than other families. Therefore to list the differences between *some* cats and *some* civets a few additions must be made as follows:

3. On each side of each jaw the cats have either 3 or 2 premolars, and only one molar. Civets *usually* have 4 premolars and 2 molars. This is not universal because the sub-family Cryptoproctinae have 3 premolars and one molar, like some of the cats.

4. The claws of civets are less retractile (could this be noticed in a fossil?) but this is not a family difference because the same feature is found in the cheetah, which belongs to the Felidae.

5. The cats have toes 5 and 4, *so have some civets*, but most civets have toes 5 and 5.

6. In *some* civets more of the foot is on the ground than is the case with the cats.

7. There is a slight variable difference in the number of vertebrae.

There is nothing else of any considerable anatomical importance.

To give a list of differences between Equus and Eohippus is not so easy as I know of no suitable book of reference, and the Natural History Museum is closed so that I cannot examine the specimens for myself, but I have found the following which, though probably by no means complete, are more than sufficient.

1. Although the skull of Eohippus is more like that of Equus than is any other part of the skeleton, it has important differences, in particular the muzzle is relatively shorter, the diastema is very

slight and the ring of bone round the orbit of the eye is absent. This balances 1 and part of 2.

2. The ratio between the body length and leg length is greater in Eohippus than in Equus. This balances the rest of 2. The family differences are already accounted for.

3. The hoofs of Eohippus are rudimentary and the animal walks with the toes on the ground instead of on the tips of the toes. This balances 4 and 6.

4. The slight difference in the teeth (3) (which does not always exist) must be compared not only with the presence in Eohippus of an extra premolar and a normal canine but with a fundamental difference in the character of the teeth so great that you asked me to try to explain how it was possible for one to be derived from the other. Here there is no comparison, the Equus-Eohippus difference is of the kind which separates different orders.

5. I have not been able to count the vertebrae of Eohippus but I feel quite certain that there are significant differences (7). Anyhow the *character* of the vertebrae, which is much more important, has entirely changed. The long dorsal spines are absent. The hollow back has absolutely disappeared. Whether Eohippus had an arched back is a minor point which can be left open. Once again the difference is of the kind which separates orders rather than families.

6. There is no difference in importance between the limbs of cats and civets except the relative length compared with the body and an extra toe in *some civets*. This fades into insignificance in comparison between the limb differences of Equus and Eohippus. Equus has one functional toe on each foot compared with 4 and 3 in Eohippus. The radius and ulna and tibia and fibula in Eohippus are normal, whereas in Equus in each limb one bone only is functional and the other is rudimentary or fused with the main bone. The proportions between the different bones of the limbs are entirely different. The adaptation for speed of Equus is not there at all. Once again the differences are such as separate orders rather than families.

I think that is sufficient. You can if you like take for comparison the most widely separated species in the families of cats and civets (which is not what is usually understood by the family difference) and you find nothing in any way comparable with the difference between Equus and Eohippus.

Personally, as I have said before, I think it unreasonable to

attach so much importance to this minor point. But you and the editor actually do so. It is therefore perhaps allowable to ask whether the editor is yet converted to evolutionism, and whether you have seen reason to reconsider your attitude towards it.

H. S. SHELTON.

DEAR SHELTON,

There is a slight difference between those who assert that the earth is round and those who hold the theory of organic evolution in that the former *can*, and the latter, including yourself, *cannot*, successfully meet objections to the theory they support.

The title of this book is *Is Evolution Proved?* I maintain that I have adduced scores of facts which are inconsistent with the theory that all living things have evolved from lifeless matter by a purely mindless process. I maintain that you have adduced no facts which are in the least difficult to reconcile with special creation. But special creation is not the issue. Your task is to justify the acceptance of evolution as a theory resting on an assured foundation as, say, Copernican Astronomy. What you have done is to show that you dislike the theory of special creation, and, like T. H. Huxley, accept evolution because the idea appeals to you. Having failed to substantiate your claim, you conclude your letter by saying that evolution is 'the only known reasonable and probable explanation of the facts of life.' I venture to suggest that some who read your letters may consider they do not bear out your assertions. For example, the editor, who asks me to say in regard to your final question as to whether he is converted to evolutionism by your arguments, that the effect of this book has been still further to reinforce his conviction that, in the words of the great botanist Reinke, 'the only statement, consistent with her dignity, that science can make, is to say that she knows nothing about the origin of man.'

Much of your letter merely consists in asserting what it is your business to prove, i.e., that morphology, embryology, palaeontology, all point in the same direction. They do, but not in the direction you wish them to point.

In places you controvert not what I have said but what you would like me to have said. Thus, you suggest that because I find a fossil and cannot find its immediate ancestor I assume it to have been specially created. I will deal with this shortly. Meanwhile, I repeat my view, that the great number and variety of fossils which

occur in Cambrian rocks and the lack of undisputed fossils in any of the earlier rocks, point strongly to a great creation of living forms at the beginning of the Cambrian period. You, despite this evidence, assert that animals existed before the Cambrian period, and you deem your attitude scientific and mine unscientific !

I notice that you are making full use of your most powerful ally, fashion, in that you devote the first part of your last letter to showing that I am out of fashion. This is true as regards the British Empire and the U.S.A., where the idea of special creation is unfashionable, not because any evidence has been adduced against it, but because it does not appeal to the 'modern mind.' It is deemed quite *démodé*. Admittedly to men of the present age—and *only* to them—the idea of a Creator suddenly producing a bird out of nothing is faintly ridiculous. But the essence of a scientific approach to a subject is the refusal to be handicapped by a fashionable prejudice. So great is the power of the fashion set by Darwin that it would be professional suicide for a British or an American biologist to declare himself in favour of special creation. School text-books therefore treat evolution as proved. The B.B.C. refuses to allow any of its speakers to attack the sacred dogma. Small wonder, then, that the professional biologists who doubt evolution keep their doubts to themselves or express these in cautious language, as may be seen in the passages quoted by Lunn in the Introduction to our debate. Thus it has come to pass that 'the man in the street' is firmly persuaded that a dogma declared to be 'impossible' by leading French biologists is proved beyond all possible doubt. The firm grip of fashion makes it impossible to persuade a professional British biologist to defend evolution in public debate.

Despite this initial advantage, you have been in difficulties from the beginning of this debate because you cannot, as Lunn puts it, 'get plus out of minus, or a quality in an effect which is not present in its cause or causes.' It does violence to the basis of logical thought to maintain that the brain of Shakespeare, our reaction to beauty and the vision of the mystic were all present in the mist, mud, sand and seas of the primeval planet.

The great merit of this form of debate, in contrast to *ex parte* statements, is that the evolutionist cannot get away with vague generalities. Popular biologists, such as Dr. Julian Huxley, write as if natural selection, which, by hypothesis, can only select and cannot create, were an adequate substitution for a Creator. He writes (*Evening Standard*, October 12th, 1927) : 'In the past of

geology the slow, wasteful and blind forces of natural selection have created the marvellous living mechanism of ant, bee, bird, horse and man out of mere living slime.'

How can selection create? It can only select from that which is already created; with as much truth might a man, who has just drowned three out of a litter of four kittens, hold up the fourth and say: 'See! I have created this.'

You are, as Lunn has remarked, extremely familiar with the literature of evolution and you are clearly a skilled controversialist. It is, therefore, not lack of debating ability but the weakness of your case that has forced you to try to rig the rules of procedure in your favour:

(a) You claim that evidence equally valid for evolution and for special creation must be deemed evidence for evolution against special creation.

(b) You call upon me to disprove statements which it is your business to prove, such as the differences between Eohippus and Equus are much greater than those between the cats and the civets.

(c) You quote from authorities favourable to your thesis, but deprecate my doing so (p. 40).

(d) It is permissible for you, but undignified for me, to issue challenges.

(e) You must be free to make deductions from the absence of fossils, but it is wrong for me to do so. Thus you are certain that mammals did not exist in the Carboniferous period because no fossils of them have been found in Carboniferous rocks, but you would consider it illegitimate for me to ascribe this non-discovery of their fossils to the fragmentary nature of the geological record.

(f) Finally you, in effect, claim the right to adapt the available evidence to the demands of evolutionary dogma. As examples of this I may mention your treatment of the Galley Hill skeleton and the Castenedolo and Calaveras skulls (p. 279).

Again, the weakness of your case is evident in the evasiveness of your replies to some challenges and your complete failure to reply to others. Here are a few cases.

You have offered no explanation of:

(1) The origin of the Organ of Corti in the mammalian ear.

(2) The spinnerets of the spider.

(3) The jumping apparatus of the click beetle.

(4) The steps by which a reptile can have been converted into a mammal.

You have offered a pitifully unconvincing account of the steps by which

(1) A reptile can possibly have become converted into a bird.

(2) A land mammal can possibly have changed into a whale.

The one supremely important fact which emerges from this is that you have completely failed to put forward any reasonable explanation of how living things could possibly have evolved by a *blind, undirected and purely fortuitous process* from the lifeless inorganic matter of which the primeval planet was composed.

I will now summarise the reasons, given in my previous letters, why I reject evolution :

1. *Palaeontological* (Chapters II and III).

The rocks have not yielded any of the fossils indispensable for the proof of evolution, apart from mere differentiation in which many creationists believe.

I have given statistics showing that animals are fossilised to such an extent as to render futile the plea that the non-discovery of these indispensable fossils is the poverty of the geological record. You have not disputed these statistics. You have, however, asked me to state the significance of the fact that fossils of 64 of the 187 shelled molluscs now living in the British area have been found in Jurassic rocks. The 64 molluscs include such familiar animals as cuttle-fish, squids, oysters, mussels, cockles, winkles, limpets, scallops, and pond- and river-snails. None of these genera has undergone any appreciable change for 150 million years. All of them particularly the cuttle-fish, are very complicated animals. *Inter alia*, the cuttle-fish has eyes almost as complicated as those of a mammal, eyes provided with a lens and an iris. If this and the other 63 complicated animals have undergone no change for 150 million years, how many billion years would have been required to allow of their gradual evolution from specks of protoplasm ?

As none of these (they constitute 35 per cent of the British molluscs) have undergone any evolution for 150 million years, it is not unreasonable to suppose that this is equally true of the other 123 of which fossils have not been found in Jurassic rocks and to believe that the reasons why no fossils of them have yet been found in those rocks are: (1) the rocks that are accessible to us have not been fully explored, (2) the Jurassic rocks that held their fossils have been destroyed in the course of time, (3) these animals formerly lived in the sea far from land, so that the rocks containing

their early fossils are not accessible to us. Thus the known fossils strongly suggest that none of the molluscs have undergone evolution.

In reply to your assertion that because I find a fossil and cannot find an immediate ancestor I assume it to have been specially created, let me say that, of the above 64 Jurassic molluscs, no fewer than 22 make their earliest appearance in Jurassic rocks. These include the cuttle-fish, squid, winkle, cowrie and the pond- and river-snails. This is capable of three interpretations, viz. : (1) All migrated in the Jurassic period to the locality in which their earliest known fossils were laid down, or (2) each evolved on this spot, or (3) all were specially created on this spot. I believe that the first is the correct explanation, and that some change in the conditions of life caused several kinds of molluscs to migrate into either coastal waters or to ponds or rivers near the sea. I believe that most evolutionists accept this explanation. The only difference between them and me is that they believe that these immigrant forms evolved in the places from which they migrated, while I believe that they were created in those or other places. As none of them has evolved since its earliest known fossil was laid down, I submit that my belief is the more reasonable. The evolutionists have to believe that these molluscs ceased to evolve from the moment that their earliest known fossils were laid down.

Between the Cambrian and the Eocene periods 220 families of molluscs make their first appearance in the rocks. If each of these gradually evolved from an earlier family, 220 series of genera linking the families must have existed. If each of these series consisted of ten genera, then 2,200 intermediate genera must have existed, and fossils of over 2,000 of them should have been found if the geological record be nearly perfect. In fact, not one has been found !

The fossils of the Brachiopods (lamp-shells) tell the same story, as do those of the mammals. As regards the latter, the tables of their fossils (p. 62) show that 100 per cent of the genera of land mammals now living in Europe have been found, and this is equally true of the whales, sea-cows, seals, etc. The evolutionist asserts that each of these groups is descended from a land ancestor. If this be the case, then, as I have shown (p. 128), at least 350 fossils of genera intermediate between these marine mammals and their hypothetical land ancestors ought to have been found. In fact, not one has been found.

I closed my letter (p. 78) with the following question, in italics : How can you account for the amazing contrast between the

richness of the fossil record in respect of genera which are known to exist and the appalling poverty of the record in respect of the genera necessary for your theory? Your case is really based on fossils which have not been found!

My second reason for disbelieving evolution is:

2. *Facts Revealed by the Geographical Distribution of Animals* (Chapter IV).

In this chapter I have shown that the geographical distribution of butterflies suggests that a period of from one half to one million years is needed for the evolution of a land species (p. 146), and much longer for a marine species (p. 146). I have shown that no oceanic island has been in existence sufficiently long for the evolution of a new family (p. 147), also that, despite the immense period during which Australia has been cut off from the rest of the land, no new order of mammals has evolved in Australia. Finally, I have shown that the earth has not been habitable nearly long enough for the gradual conversion of a protozoan into a mammal (p. 149).

My third reason for the rejection of evolution is:

3. *Certain Morphological Facts* (Chapter V).

You tell me that you do not claim to be able to solve every morphological difficulty I have raised. I put it to you that you have failed to solve almost every such difficulty. On p. 304 of this letter I have mentioned six of these difficulties. Let me add a seventh: the request I made to you to draw up a phylogenetic tree of any Class or Order linking all the animals composing it (p. 177).

If you think you have met any of the above seven points, please give me an adequate reference to your reply.

As regards the gradual change of a reptile into a mammal, I pressed you to reply to this on p. 171. I put it to you that the changes you would have to describe are so impossible that a description of them would subject you to ridicule. This being so, if you do not state how you suppose this happened, I will in my next letter reproduce what a well-known evolutionist has said on this subject.

I take exception to your description of the hind part of the vertebral column of the whale. It does not 'twist round so that the dorsal processes become horizontal.' The vertebrae in the tail differ from those in front in being smaller, wider transversely and

flatter, and movable one upon another. To say that they have *become* different is to beg the question. The established fact is that they *are* different. Doubtless they are adapted to swimming, but to say that they have *become* adapted is to make a statement unsupported by any evidence, an assertion, moreover, that imposes on you the burden of showing how such adaptation can have been the result of the accumulation of small variations. *How did the ancestors of the whale contrive to swim while in the transitional condition?*

The hind legs of the seal are its chief swimming organ; in the sea-lion the fore limbs play this role. The mode of locomotion of these two animals is quite different, both in the sea and on land. Sea-lions are not in an intermediate stage between a land quadruped and a seal. Please explain why two kinds of land quadrupeds ceased to use their hind legs in the normal manner with the result that one turned into a whale and the other into a sea-cow, and (2) why a third land quadruped ceased to use its hind legs in the usual way and changed into a seal, and (3) why a fourth ceased to use its hind legs in the usual way and became a sea-lion. Please describe the intermediate stages in each of these three types of transformation.

In this and in other chapters the fallacy recurs that morphological resemblances necessarily denote genetic relationship. Lunn has dealt with this matter. An illustration of this is your mention of some similarities between the larvae of modern animals and adults of ancient ones, and your inquiry why should these exist except on the ground of genetic relationship. The answer is: in view of the fact that every animal has to have feeding, breeding, breathing, excretory, etc., organs, and the existence of a million species all constructed on one of a few general plans, it is inevitable that some members of an Order resemble those of another Order. Such resemblances occur between very widely separated animals.

My fourth reason for rejecting evolution is:

4. *Experimental Evidence is Against It* (Chapter VI).

I have pointed out how little breeders have been able to modify animals, and I asked you to name any *new* structure any breeder had produced. You have not done so.

I asserted that we know of no apparatus whereby a protozoon could be converted into a reptile or a mammal by the accumulation of small variations, and asked you, if you disagree, to name such a mechanism. You have not done so.

I asserted that the experimental evidence is fatal to the evolution theory because scientists, with all their knowledge and apparatus, have not been able to convert the most complicated organic substances, much less inorganic matter, into living matter. In consequence, it is futile to believe that blind, unintelligent natural forces can not only have converted inorganic into living matter, but endowed some living organisms with a high degree of intelligence. Far from making any comment on this, you replied that you had found very little in my letter that needed reply, and that the experimental evidence is 'just what is needed' !

My fifth reason for rejecting evolution is :

5. *Embryology Does Not Support It* (Chapter VII).

You believe that Equus is descended from Eohippus, that had four toes on the front and three on the hind foot. You say that the horse embryo exhibits three toes on each foot because it is descended from a three-toed ancestor and its embryo recapitulates ancestral history. In that case, why has the horse embryo not four toes on the front foot? Like nearly all transformists, you invoke recapitulation when it suits you and reject it at other times. I say that three rays develop in the foot of a horse embryo because there are three bones in the adult foot, the foot bone and the two splint bones.

You cite as embryological evidence for evolution your opinion that 'instead of going in a straightforward way to the formation of the adult form, the embryo develops in a devious way dependent on the lines of development of the ancestor.' As examples of this you mention the development of 'the well-known branchial arches' and the fact that 'no less than three successive excretory organs develop in higher embryos.' You deem these facts evidence that the higher vertebrates have evolved from fishes. I assured you that there is no justification for the opinion you hold and that *developing embryos take the most direct route, and that every stage in their development is dictated by physiological and mechanical necessities*, and I described how the heart, blood-vessels and kidneys develop, and I challenged you to show how their development could be more direct than it is. In reply to my challenge you wrote : 'I don't know how they would have developed if mammals had not descended from fishes, but they would certainly have developed more directly than they do.' As to the kidney you wrote : 'I cannot in any circumstances undertake to elucidate how an organ ought to have developed.'

Despite your failure in the chapter on Embryology to substantiate your claim that the development of the embryo is not direct, you in your last letter cite as positive evidence for evolution 'the development of the embryo to the adult is not direct' !

You cite as embryological evidence for evolution that the visceral arches, instead of forming 'considerable structures,' form 'insignificant ones, such as the thyroid cartilage.' As there are no large organs in the region of the visceral arches, I asked you to name five pairs of considerable organs you would expect these arches to have produced. This question you have ignored.

Every stage in the development of every embryo can be satisfactorily explained independently of all idea of the recapitulation of ancestral stages, by the facts : (1) as von Baer demonstrated long ago, embryonic development invariably proceeds from the general to the particular and from the simple to the complex ; (2) the resemblances in the embryonic development of a fish and a mammal occur only in the earliest stages, i.e., those in which the features common to all vertebrates are developing—head, body, tail, backbone, two pairs of limbs, etc. After this the resemblance ceases. Thus there is no warrant for basing any argument for descent on these resemblances.

If you rely on embryology for evidence of evolution, you must either regard its testimony as false in some cases or abandon your theory that man and the apes are near blood relations, because at no stage in its development does the human embryo resemble that of an ape. I have quoted Keith on this matter (p. 270). Here is a later pronouncement : 'Man in all ontogenetic (i.e., embryonic) stages shows characters . . . which is impossible to admit could have been developed from any stage that had once assumed "simian" characters' (Wood Jones, *op cit.*, 1944, p. 30). Here you have two of your witnesses contradicting one another. Morphology says man and apes are cousins, Embryology says they are not ! Which of them do you accept ?

My sixth reason for rejecting evolution is :

6. *No Animal Exhibits an Organ in a Nascent State* (Chapter VII).

As creationist I do not expect to find nascent organs in animals, but I do expect to find that practically every structure in every animal has some use and that is why it exists. You, as an evolutionist, expect to find in every animal a number of useless structures (you suggest 180 in man !). When I point out that what you regard

as a useless structure is useful you dispute this, as in the case of the body-hairs of man and the semi-lunar fold in his eye. As regards the latter, I may here say that the fact that this has a layer of cartilage in other mammals as well as in man does not account for the existence of this layer in mammals in view of the fact that birds and reptiles thrive without it.

Your attitude is that, when you cannot see a use for any structure, that structure is useless. This attitude is rather surprising in view of the fact that many structures formerly thought to be useless are now known to have most important functions. As late as 1890 the ductless glands were regarded as useless vestiges. To-day we know that most of them are absolutely indispensable structures. Of these it may be said that the stone the evolutionists rejected is become the head of the corner.

I regard as quite unsuccessful your attempt to meet my objection to the evolution theory that nascent organs do not exist.

My seventh reason for rejecting evolution is :

7. *Many Instincts and Habits Cannot have Evolved Gradually* (Chapter IX).

As examples of the products of what Lunn calls hit-or-miss instincts, I have cited the instincts to construct nests of the kind made by the sunbird and the house-martin, which, until almost as perfect as they are to-day, would be veritable death-traps. I asked you to describe an evolutionary series of nests leading from a scrape in the ground to one of these nests. You have not done this. The fact that hundreds of animals have instincts or habits that cannot have originated gradually is, in my view, a fatal objection to the evolution theory.

My eighth objection to the evolution theory is :

8. *Man Cannot have Originated Gradually* (Chapter X).

You have not attempted to show how the blind forces of nature can have endowed man with his intelligence, power of speech and sense of beauty. As to the evolution of man's body, the appendix to my letter p. 259 shows that many different views are held regarding man's supposed animal ancestor. This diversity of opinion exists because there are serious objections to *any* known kind of animal having been gradually transformed into a man. Man occupies a very isolated position. I have given reasons, which you have not gainsaid, why man cannot have been derived gradually

from an ancestor having a hairy coat to which the young could cling, or quadrupedal gait, or an opposable great toe. If man be derived from an ancestor having these attributes he must have come into being *per saltum* as the result of a huge mutation and thus be a special creation as I understand the term.

In your last letter on Man (p. 284) you say that I make a great deal too much of the Galley Hill skeleton and 'the suggestion that the skeleton was a burial is based on the extreme improbability that the complete skeleton would be laid down in a gravel deposit.' But the skeleton was not laid down in a gravel deposit but in a bed of loam. 'There can,' writes Sir Arthur Keith (*Antiquity of Man*, p. 257), 'be no doubt that the skeleton lay in the lower bed of loam —the one under the Chellean gravel.'

The Castenedolo skull was found on the side of a hill in a stratum, the Pliocene age of which is beyond dispute. The skull was surrounded by and impregnated with clay containing Pliocene fossils of molluscs. In order to have buried this skull from the surface the sorrowing relatives had to dig through a few inches of surface soil, then through a stratum of clay over six feet deep, then through a second stratum of clay some two feet thick, then through four feet of yellow sand containing Pliocene shells, and finally about two feet into a stratum of blue clay to the resting place of the skull. Having dug this very deep grave, the diggers must have refilled the hole they had dug in such a way that none of the strata through which they dug or the fossils they removed show the least trace of having ever been disturbed. If you can believe that all this happened, I can only say : 'If you could believe that you could believe anything,' as the great Duke of Wellington said to the man who greeted him with the words, 'Mr. Smith, I believe.' The fact that five or six other human fossils are treated by evolutionists as they treat the Galley Hill skeleton and the Castenedolo skull shows to what lengths some people will go in support of their beliefs.

You rightly remark that the existence of man of modern type in the Pliocene period does not prove that man is not descended from some animal, but it does prove that so far no fossil has been found of even a probable ancestor of man. It is this manipulation of the fossil evidence to which I take strong exception.

When analysed it is found that none of the facts adduced in support of evolution show more than evolution or differentiation within the family which is accepted by many who believe in special creation.

It may be that some of the facts you have adduced are easier to reconcile with evolution than with special creation, but I contend that the arguments against evolution are far stronger than those in its favour. Indeed, the difficulties of the evolution theory are so immense that it seems to me that we must either accept special creation or, as does the French zoologist Cuénot, resign ourselves to crying 'Ignoramus !'

I shall have achieved my purpose if I have convinced readers that the foisting of evolution on school children and undergraduates is a crime against Science, for, as T. H. Huxley said, 'an assertion which outstrips the evidence is not only a blunder but a crime.'

APPENDIX

I am glad that you have at last adduced some evidence in support of your claim that the differences between Eohippus and Equus are *much greater* than those between the cats and the civets.

Your list of the differences between the last two is not nearly complete, e.g., in respect of the ear you have not mentioned the carotid foramen in the inner side of the bulla or the constriction of the latter, and the shape of the auditory canal. You have not mentioned the various differences in the palate or those in the jaw. Nor have you stated that in some of the civets the ring of bone round the ear is not closed. You have dealt with differences in the number of the teeth but not in their form, and in order to help your case you have included Cryptoprocta that occurs only in Madagascar among the civets, but some authorities think it should be classed in a family by itself.

Nor is this all. In the case of the Equidae you compare one genus, Eohippus, with another genus, Equus, and list *all the differences* between them that you can find ; but in the case of the cats and the civets you compare a group of genera of the former with a group of genera of the latter and list *none* of the differences except those between every genus of one group and every genus of the other. You then compare these lists, which are not comparable. What you have done is on a par with excluding from a list of differences between the British race and the Japanese race such features as height, weight, colour of hair and of skin because some Japs are as heavy and as tall as some Englishmen, and some Englishmen have hair as black and skin as yellow as some Japanese !

As you have selected in the case of the horse the two genera

which display the greatest differences, you should have selected for comparison in the case of the cats and civets the genus of civets differing most from the cats and that of cats differing most from the civets. So far as I am aware no one has done this in the case of the cats and civets, but Mivart has listed the characters of the civet genus Viverrus which are not found in any genus of cat (P.Z.S. (1882), p. 147). He lists 46 such characters of which 38 relate to skeletal parts. If you add to these 38 differences, say another 12, for differences between the extreme genera, you get a total of 50, and to support your contention it is therefore up to you to name about 75 differences between Eohippus and Equus.

Our readers will doubtless realise that your attempts to magnify the differences between Eohippus and Equus are made on account of your inability to produce a series of fossils linking one family with another and that up to the present there is nothing approaching proof that any family has given rise to another family.

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

I have looked through your last letter to find if there are any particular points which need attention and it is difficult to know which to choose. I need say very little more about the Galley Hill skeleton and the Castenedolo skull. I regard the former as probably Chellean and possibly Strepyan. Whether or no it is a burial is of very little consequence. The Castenedolo skull is, I believe, almost universally rejected. But in any case it does not affect the evolutionary descent of man. There is no evolutionary reason why a species should not remain practically unchanged for a million years or so. In fact, they very often do. I can only suggest that anyone interested in this matter would do well to read Keith's *Antiquity of Man.*

In your appendix you have certainly succeeded in confusing the minor question of cats and civets beyond my powers of disentanglement in such brief space as I can give to it. I cannot, however, refrain from pointing out that you seem to be unaware how the points you raise tell against you. You speak of the Cryptoprocta as possibly being a separate family. If that is so, it is a sufficient answer to your challenge to compare the difference

between cats and Cryptoprocta with that between Equus and Eohippus. As this genus is unusually like the cats, this is much better for me than the difference between cats and civets generally. I am a little disappointed with your treatment of this matter. It is a plain morphological point concerning which you have not the excuse of an unusual metaphysical attitude. Anyhow, I have dealt with the matter sufficiently fully in my last letter, and so I shall now leave the point to the judgment of the reader.

I find a similar confusion in much of your last letter. It is necessary to warn the reader to refer to my statements before accepting your account of them. One flagrant example is found on page 304, where you tell me that I infer the absence of mammals in the Carboniferous from the fact that fossils have not been found. If, however, you will look at page 295 of my last letter you will find I tell you I do not. It is a little difficult to argue with an opponent who knows what you mean so much better than you know yourself.

I am sorry you think it necessary again to air your grievance when I am doing my best to remedy it—if it exists. Anyhow, you have now a public debate. Whether you have made out a case is for the reader to judge. What you describe as the cautious language of biologists does not seem to me to be anything of the kind. The causes of evolution are obscure, and many biologists say this quite plainly. This explains a number of Lunn's quotations—and yours. With regard to the *fact* of the occurrence of evolution, I cannot find in your exposition any serious difficulty of principle. Of course, there are difficulties of detail. I do not know how the organ of Corti has evolved, and do not see that I am called upon to try to guess. The same applies to most of your 'challenges.' I therefore propose not to answer your last letter, but to regard it as your statement of the anti-evolutionary case, intended to balance my last letter (p. 286). Instead of doing that, I will say a little about this very involved and difficult question—the causes of evolution.

This discussion is now in order. Before dealing with it, it was necessary for me first to make it quite clear that evolution had taken place. Whether I have succeeded in doing this is for the reader to judge. I must now, however, for the sake of argument, assume that the case for evolution has been sufficiently expounded, and that there is no reasonable doubt that it has occurred, otherwise there would be little point in what follows. It would not be sensible to expound the probable and possible causes of something

that did not exist. I will start by quoting the brief statement I made in the first chapter (p. 55) :

'I think the variations that normally occur and can be observed in living creatures are all that is required. These, though small, in course of time add up to the changes that have actually taken place. According to environment, and to the changes in the environment, and to the movement of the organisms to other environments, some variations will survive and others be eliminated. This is usually known as natural selection. The causes of the variations are unknown. We know they occur but we do not know why. Personally, I believe in a small factor of use inheritance, but this is merely a personal opinion.'

We must note first that there is more in this statement than meets the eye. It definitely dissociates me from thinkers like De Vries, who postulates a series of enormous variations. I do not deny the possibility that variations larger than usual may at times occur. If they occur they would be propagated according to Mendelian laws, and so would not be swamped. If of survival value they would survive, otherwise they would disappear. They must not, of course, in any case, in animals, be of such a size as to imply physiological infertility, otherwise they would automatically be eliminated. My objection to regarding large variations as a considerable factor in evolution is merely that it seems to me reasonable to use known causes so far as they will serve us, and I think these are sufficient. Moreover, neither Micraster, nor the Equus-Eohippus series, which are our best examples of observed evolutionary changes, give any foundation for the postulation of unusually large evolutionary variations.

With regard to small variations, there is of course no doubt whatever about their existence. No two individuals are exactly alike. Here, of course, we are faced with the serious complication that we do not know exactly what differences are inherited and what are not. Differences like those between the larger and smaller peas in the same pod are not inherited. But in matters of this kind I should like to deprecate undue dogmatism. So far as *first order* observations are concerned, we can point out a fairly clear distinction between inheritable and non-inheritable variations. But nature does not proceed only by processes which can be unravelled by rough first order observations, and, in millions of generations, effects that are not immediately observable may be important. The present genetic researches on comparatively large variations are

only the beginning of the study of heredity. All the same, so far as first order results are concerned, we have to note and accept the difference between inheritable and non-inheritable variations.

Now let us consider the variations which are studied genetically. Why do they occur? They are universally referred to the chromosome outfit. This is a fact of nature which can well be described as miraculous. We have what appears to be a series of enormous molecules, probably of the proteid type but much more complicated. Very little is known about their molecular constitution. They are arranged in a definite order, and are different for different species, and presumably also have minor differences within the species. This ultramicroscopic series of molecules in some extraordinary and unknown way determines the structure of an elephant, or of a human being. It seems to me to require emphasis that no one has the least idea why this occurs at all. This basal fact should make us very modest in our attempt to unravel the causes of evolution. Why are there variations? The first point that occurs to me is that we are putting the wrong question. Every organic chemist knows the instability of chemical compounds much less complex than those we have to consider—to mention only one aspect there is the possibility of tautomerism, and possible variations in the tautomeric balance. It can be assumed that, as a certain series of these marvellous complexes determine a vast and imposing structure, variations in the complex will imply variations in the resulting structure, though the causal nexus is wholly beyond our comprehension. It therefore seems to me that the question we ought to ask is not why there are variations, but why there are so few of them. Variation does not seem to me to need explanation at all; what does need explanation is the extraordinary stability. On these theoretical grounds De Vries' suggestion seems exceedingly plausible, and it is on grounds of observation, not on theoretical principle, that we reject it. I am inclined to suggest that this stability is the result of countless generations of natural selection in the early stages of the development of life. Without a relative stability, the close approximation of the characteristics of species to the structure fitted to their environment would be impossible. Unduly variable species would be eliminated. Similarly, if the stability became absolute, and the variations necessary for survival did not occur, again the species would be eliminated. It seems to me that the relative stability, and the small amount of instability still remaining, can well be regarded as products of natural selection; but even then it

is the stability rather than the variability that needs explanation. I think we need no elaborate explanation of variability, as it is plainly inherent in the very nature of the chromosome outfit.

I have no space, nor do I think it necessary, to discuss at length fruit flies, genes, and Mendelian laws. It is well, however, to raise once more a point I emphasised earlier in the discussion. The workers on fruit flies and other species have done valuable work in showing the localisation of the causes of certain variations in definite parts of the chromosomes. This has been described as the discovery of genes, and the description is a very good one within certain limits. All the same, we should not forget that we have not the least idea what happens to the so-called gene, why its alteration should produce variations, and, more important still, we do not know, except in a few obvious cases, what other changes in the body of the animal are correlated with those we have observed. Valuable as this work is, it rests on the roughest empirical basis. For this reason I wish to urge theorists to be a little less dogmatic in their treatment of the concept of genes. In particular, I think it important to call attention to what is often overlooked, but what would at once be admitted by any clear thinker—the fundamental unity of the whole chromosome outfit.

This antithesis is a very old one, and was apparent in the first stages of evolutionary discussion in the contrast between Darwin's pangenesis and Spencer's physiological units. The present outlook of many contemporary biologists has a considerable resemblance to the pangenesis theory, with the difference that the genes are not supposed to come from all over the body, but are there already. This fits many of the facts very well. There certainly is localisation. The aspect I am trying to add to it is that of the physiological unit. This is not, as Spencer thought, intermediate between the molecule and the whole cell, but is the cell, or at least the nuclear part of it. When we remember this aspect, we tend to be cautious in exaggerating such localisation as we have observed, and are better prepared to look for correlated variations, which, needless to say, do occur, and have been observed. It is desirable to emphasise that correlated variations are a necessary assumption, and that without doubt a change which is described as an alteration in the gene for a wing (for example) must in subtle ways imply a change in the whole organism. Once again, as it is not variations but their rarity that most needs explanation, so it is not correlated variations that need explanation, but rather that there are not more of them, and

that they are not more obvious than they actually are. It is the relative localisation (for obviously it can only be relative) that calls for explanation, and once again I think we can refer this fact to the action of millions of years of natural selection, because obviously this localisation does enable natural selection to work in a more specific manner.

This theoretical statement, which cannot help but be somewhat involved, seems to me to throw some light on the question raised by the editor in the introduction, which you have repeated in one form or another all through the discussion. Obviously, natural selection can only select from what is there ; we all know that, and I do not think we need reminding. The question that arises, therefore, is whether or no we can rightfully expect variations to occur ? There can be no doubt that they actually do occur. But it makes a difference whether we naturally expect them, or whether we have to regard them as something extraordinary. I have attempted to show that they are naturally to be expected, and that what needs explanation is not their occurrence but their rarity. The real problem that is at present entirely beyond our understanding is the nexus which connects the constitution of the chromosome outfit and the structure of the organism. All the same, though we do not understand it at all, there can be no doubt whatever that it exists. Granting this correlation, which cannot be denied, the real problem is not to explain variations, but to explain why the chromosome structure is as stable as it is.

Up to the present, obviously, we cannot postulate anything more than random variations, in the sense that we have not the least idea what sort of variations are likely to occur. We must however, be very clear what we mean by random variations. The randomness of the variations is merely an expression of our own profound ignorance. We have not the least idea how and why the chromosome outfit determines the structure of the organism, nor of the nature of the molecular changes that occur in it. We cannot, therefore, correlate all these unknowns and say what variations result from what changes. All the same, I think we are entitled to assume that there is nothing random in the nature of things, and that, in some way not at all understood, the molecular changes in the chromosomes (or, if you like, the genes) do absolutely determine changes in the structure of the organism. This makes it clear that all this talk about blind chance, and getting plus out of minus, is not very sensible. The blind chance is merely a clumsy way of

expressing our own ignorance, and plus and minus are not concepts which have any bearing on the question whatever. These things which happen are entirely unexplained, and we shall do well to leave it at that.

Let us now pass on to another point, and that is whether there are any gleams of knowledge modifying our profound ignorance, and whether we can reasonably expect to be able to see or to anticipate any direction in the changes that take place. Needless to say, as we advance step by step, each further advance becomes more and more speculative. All the same, I think to a certain extent we can give a positive answer to this question. There are certain correlations which have been observed, and which I think are worthy of mention. One of these has already been noted in this discussion, and that is that we have had examples of how in certain cases changes which arise first in the adult seem to work their way back in time to the young, and even to the embryo. There are several of these in the Equus-Eohippus series. In Merichippus, for example, the cement in the teeth is deposited later than in Equus (S. 348), in Merichippus also the milk teeth have no cement (H. 253), whereas in Equus the milk teeth have cement like the permanent teeth. In Merichippus the colt has a small separate ulna, which in the adult fuses with the radius. In Equus the fusion is also found in the colt. In the later Merichippus specimens the premolars are like the molars, but only those of the adult. The milk teeth are of a simpler pattern. In Pliohippus the molar-like premolars are in the milk teeth also. These facts are a somewhat slender basis, but all the same I do think it worth considering whether we have not here a general tendency. Of course, natural selection will account for this to some extent, but I am inclined to suggest that there is more in it than that. Let us assume, as we are bound to assume, that a certain chemical change in the chromosomes is the cause of the variations. It is reasonably possible that such a change will spread to similar molecules, and so eventually a change in the organism, which originally appears at one place or at one time only, may become more general. There does seem to be a certain theoretical foundation for the expectation that a partial change of this kind will spread.

A few words are now desirable about the much-discussed problem of use inheritance. This has been a disputed question since the early days of evolutionary theory, and is not yet settled. Needless to say, I cannot hope to settle it now. At the same time, I do wish

to deprecate undue dogmatism on this point. Here we are concerned, not with first order phenomena of which we know a little, but with second order phenomena of which we know practically nothing. Consequently experiments and observations are inconclusive. All the same, I think that both observations and theory give some ground for the Neo-Lamarckian view. A recent book by Professor Jones, of Liverpool, entitled *Habit and Heritage*, states some facts which are difficult to explain on any other hypothesis. One of these is the arrangement of the parting of the embryonic hair of certain mammals in the exact places where it is convenient for the animal to do its toilet with its fore and hind feet respectively. This is too trivial a feature to be the result of natural selection. It could hardly affect the survival of the animal if the embryonic parting were arranged differently, or indeed if there were no natural parting at all. Use inheritance explains, and I cannot see any other reasonable explanation. This shows the kind of feature which gives some evidence, and also the difficulty of adducing evidence. When such an adaptation has definite survival value, the opponent will always say it is a result of natural selection, and obviously most adaptations of the kind will be of this character. Consequently, it is exceedingly difficult to mention any facts for which an alternative explanation cannot be suggested, and observations and experiments at the present time will naturally be inconclusive. All the same, I think there are a considerable number pointing in the same direction.

The next aspect of this question is whether, on genetic theory, we can imagine a reasonable ground for expecting such a result. I do not think this is impossible. If we take as our starting point (as we must) the correlation between the structure of the chromosomes and the bodily structure of the organism, a very natural question is whether the correlation is reversible. No one knows, but it does seem probable. Would a change in the organism by use or disuse (use more probable than disuse) produce a corresponding change in the chromosomes of the undifferentiated cells in its immediate neighbourhood. We don't know, but it seems probable. If so, can this change spread sufficiently to work back into the genetic cells? It does not do so always or regularly, that is obvious from experiment. But does it do so at all? I think this is a factor which could be interpreted by statistical laws. All that is necessary for the suggestion of use inheritance is that it should do so *occasionally*. I think, contrary to the general impression, that, even working on

modern gene theory, we may still regard use-inheritance as a theoretical possibility.

The conclusion I would draw from all this is that those like myself who incline to the theory of use inheritance have some foundation both in observation and in theory for their views. It cannot at present be either definitely proved or disproved in view of all the possible alternative explanations. This can only be done if and when first order effects are more fully understood, and second order effects can then become the subject of intensive investigation. In the meantime, all that I am definitely asserting is that use-inheritance, while not definitely proved, is very far from being disproved, and that it is quite reasonable to hold it provisionally as a probability, while recognising that others may take a different view.

The last question that needs brief consideration is the general one of design. This is a metaphysical question, and I think one fundamental error which underlies all your reasoning is that you do not clearly recognise it as such. My own view here is that it is not a question with which science can deal at all. Obviously the crude theory of design advocated by Paley has gone. Adaptations are not absolute, but only relative, and they are continually changing. Variation and natural selection, which we can see at work, take the place in rational human thought which Paley sought to fill with particular Divine dispensations which we can only imagine. Anyhow, this idea of particular design was an uncomfortable theory. If we wish to apply design to particulars, we can find just as much design in a malaria parasite, or in a tapeworm, or even in the germs of typhoid or plague, as we can in a water spider or a human being. I do not think this will do, anyhow. In the light of our present knowledge, it can well be swept away like the cobwebs in a long deserted building.

There still, however, remains the metaphysical idea of design in general. Is the whole universe, the whole scheme of things, the product of design? What has evolution to say on this matter? This question has been raised by you and the editor from time to time with a number of question-begging epithets, and I think it requires an answer. The answer is perfectly clear and explicit. *On this matter evolution has nothing whatever to say.* I have no patience with these question-begging epithets, atheistic evolution or deistic evolution, or theistic evolution (whatever the difference between these last two may be). Evolution is none of these things. Modern science (natural science) is not concerned with these problems.

We know as a matter of fact (I hope I have shown this conclusively), that evolution has taken place, that the multitudinous forms of life are genetically connected. To a certain extent, but to a very limited extent, we can unravel a few proximate causes. That is all. No doubt in the future much more will be unravelled. But we know nothing in science of final causes. To bring this metaphysical question into scientific investigations is merely a nuisance and an irrelevance. You are quite right in asserting that your idea of special creation does postulate a *vera causa* in the mediaeval metaphysical sense, whereas modern evolutionary science is entirely unable to do anything of the kind. If this admission is of any use to you, you are welcome to it.

All the same, though evolution is neither atheistic nor theistic, it is possible to interpret it either atheistically or theistically according to your particular religious and metaphysical turn of mind. If you are inclined to see design in nature, you will have no difficulty in finding it there. If you like to assume the agnostic attitude and say that this concept of design is merely an anthropomorphic interpretation of something that is wholly beyond your comprehension that is equally rational. These questions of theism, agnosticism and atheism belong to religion and to metaphysics, not to science. I feel a little disinclined to enter into the matter at all. Personally, I incline to the theistic interpretation, but I wish to make it clear that this is merely a personal metaphysical attitude and has very little to do with the subject of this book. Questions of this kind must be decided, so far as decision is possible, on other grounds, and I have written a book dealing with them at length, and do not care to repeat or summarise here.

Where we differ in our interpretation of this matter is that I maintain a much greater separation between physical causes and metaphysical interpretation. I see the miracles in common things ; but it does not assist scientific investigation to emphasise this aspect. The real miracle (in the sense of being entirely beyond our understanding) is the overwhelming fact that these microscopic chromosomes do in some unknown way determine such vast and unaccountable changes. We have no idea how this happens ; but it is clear before our eyes whenever we study an embryo. All the same, we assume that we have a natural process, and we proceed to try to unravel it—with indifferent success. Realising this as I do, I am not tempted to look beyond natural processes to account for the evolution of living things.

I think this will do. In any case I have no space to elaborate the topic further. I can at least assure you that I have no desire to evade these speculative questions. Few things are more congenial to me than theorising on larger scientific issues. At the same time I wish to make it clear that the evidence for evolution is definite and positive, and that theorising about the causes is in a different category. The evidence I have given for evolution throughout the discussion is in the main such as would be universally accepted. The theorising, to a much greater extent, is personal and individual.

Yours sincerely,
H. S. SHELTON.

DEAR SHELTON,

My attempt to condense my last letter because of shortage of space has been the occasion of your taking exception to my remark : 'you are certain that mammals did not exist in the Carboniferous period because no fossils of them have been found in Carboniferous rocks.' I should have added : 'and because the existence of mammals in the Carboniferous period would seriously upset the evolution theory.' Your attitude is : the fact that no recognisable fossils have been found in Pre-Cambrian rocks does not mean that animals did not exist when these rocks were formed, because the evolution theory asserts they did exist then. But the fact that no fossils of mammals have been found in rocks of the Carboniferous period means that mammals were not then in existence because the evolution theory demands this. Thus you make all the negative evidence support your view !

In this correspondence you have evaded all attempts to show how certain instincts of the hit or miss variety could conceivably have originated by any process of slow evolution. I never asked you to produce a theory which you could demonstrate to be true. but I did ask you to produce a plausible guess which you could demonstrate not to be intrinsically absurd.

In your letter you have confused two very different things. I am well aware that many phenomena may be inexplicable because we do not possess the necessary data, but it is one thing to be able to *prove* a particular explanation and quite another thing to be unable to suggest any plausible explanation as to how a particular fact can be reconciled with your theory.

As in the course of your remarks on the causes of evolution you admit that modern evolutionary science is entirely unable to postulate a *vera causa* of evolution and that I will have no difficulty in finding design in nature, all that I need say on this subject is : (1) no amount of shuffling or rearranging of genes and chromosomes or parts of these can do more than effect changes within the type ; it is fantastic to imagine that such could result in the production of an elephant, a fish or a mollusc from an organism lacking eyes, ears, legs, heart, blood-vessels, liver, spleen, lungs, bones, muscles, etc. Not only is there no known mechanism for accomplishing this feat, but, as Dr. R. E. D. Clark writes (*Trans. Vict. Inst.* (1943), p. 75) : 'The more carefully the matter is considered the clearer it becomes that if in past ages complex organisms ever did evolve from simpler ones, the process took place contrary to the laws of nature and must have involved what may rightly be termed the miraculous.'

(2) You are quite out of date in asserting that the theory of design advocated by Paley has gone and can 'well be swept away like the cobwebs of a deserted building.' The theory to-day is very much to the fore. Even Prof. J. B. S. Haldane, F.R.S., contributed to *The Rationalist Annual*, 1944, an article entitled 'The Argument from Design,' in which he admitted that it is by no means proved that the whole course of evolution from single-celled organisms to oaks, daisies, ants and men can be explained by animals adapting themselves to their environment without any conscious planning by themselves or anyone else. There are real difficulties in the evolution of such an organ as the eye, where many parts must vary together to produce an improvement.

I note your admission that there are more differences between cats and civets than you stated, and that you have not added to your list of differences between Eohippus and Equus.

This correspondence shows clearly that your belief in evolution is based, not on evidence, but on dogma. As Davies and I wrote (*Obsessions of Biologists* (1945), p. 2) : 'When we examine the often conflicting and mutually incoherent arguments offered for the belief in organic evolution, we find that the whole case is based on the dogma of continuity, and also that there are certain propositions regarding which many transformists are now so positive that they abandon scientific method and exhibit clear marks of obsession whenever the same are approached.' We noticed seven of these obsessions : (1) That Man is descended from an ape. (2) That

Man is descended from a fish. (3) That Evolution is a higher concept than Creation. (4) That Special Creation is incredible. (5) That belief in Special Creation is unscientific. (6) That evolution eliminates miracles. (7) That there are no competent critics of evolution. You seem to subscribe to all these except Nos. 4 and 7. In addition to these you have exhibited in this correspondence 3 further obsessions: (1) That every animal exhibits a large number of vestigial structures. (2) That belief in Special Creation is the consequence of confused thought. (3) That the anatomical differences between Eohippus and Equus are enormous. As to (1) formerly zoologists tried to discover the use of structures of which the use was unknown; to-day they try to show that useful structures are useless! When I point out the use of the human body-hairs, you say this 'is a relic from pre-evolutionary times when it was thought necessary to find a use for everything!' So you really believe that man during millions of years, has been unable to rid himself of these thousands of useless hairs, muscles and sebaceous glands. In support of your contention you make some misleading statements, e.g., 'hairs are not necessary for the working of sebaceous glands, because in certain parts of the body in which this oiling effect is really required we have sebaceous glands, but no hairs.' You do not say that in the only parts of the body, i.e., the nipples and another tiny area, where these glands occur without hairs the glands are of different design, being much larger and their ducts open direct on the surface of the skin! Similarly when you point out that the skin is not dry on the palms of the hands and soles of the feet, where there are neither hairs nor sebaceous glands, you do not tell our readers that here the sweat glands are far more numerous than anywhere else on the body; according to Krause there are 2,800 sweat glands on each square inch of the palm and nearly as many on the sole. Clearly then the body-hairs of man are useful.

As to your denial of the use of the semi-lunar fold of the human eye, and your assertion that its equivalent is functional in many mammals, and it would be interesting to find out in which mammals it is useful and in which it is vestigial, I put it to you that this fold or its equivalent is useful in whatever form it occurs, and it is absurd to believe that in many species having a nictating membrane that moves over the eyeball, this structure has become gradually smaller and less movable so that we see it in all stages of degeneration.

(2) As evidence of your obsession that belief in special creation

and anti-evolutionism are the result of confused thought. I cite your remark (p. 52) : 'Anti-evolutionism is confusion of thought,' and (p. 114) : 'I must say quite bluntly that I regard the hypothesis, as too silly for serious consideration, indeed I do not regard it as a hypothesis at all, but merely one of those confusions of thought which removes some anti-evolutionists from the class of people with whom it is possible to conduct a rational discussion.' See also p. 133.

(3) That you are obsessed by the notion that the anatomical differences between Eohippus and Equus are enormous is shown by your assertion (p. 95) 'The difference between Equus and Eohippus is of the kind that exists between different orders or at least sub-orders.' Two causes have contributed to this obsession : (a) your reliance on views expressed by authorities many years ago. when our knowledge of the fossils was much less than it is to-day, and (b) your reliance on views expressed by writers of popular books on evolution.

As to (a) you make much of the fact that Owen over 70 years ago named the Eocene horse fossil found near Herne Bay Hyracotherium lepinorum, not recognising it as a horse. At that time no fossils of Eocene horses had been found in America. All that Owen had to go upon when naming this fossil was a much-mutilated skull with both the front and hind parts missing ! Owen, knowing no other part of the animal, deemed it to be a creature intermediate between a pig and a hyrax or coney. Gaudry, however, thought it was related to the apes ! About the same time as the discovery of this fossil two molar teeth were found at Kyson in Suffolk, which Owen deemed to be those of a monkey, and so he named this fossil Macacus eocoenus. But on further examination he found that the molars were like those of Hyracotherium, accordingly he changed the name of this fossil to Hyracotherium cuniculus—the rabbit-like Hyracotherium. As the teeth of Hyracotherium are so unlike those of the modern horse, it is not surprising that Owen never thought of looking among the horses for relations of this little animal of which nothing of the skeleton was known. As soon as a more or less complete skeleton of Eohippus was found, it was at once seen that Hyracotherium is a horse. (b) I regret to have to say that many zoologists when popularising the theory of evolution, in order to provide strong evidence and simplify matters, make statements they would not think of making in a scientific book. Professor W. B. Scott's *Theory of Evolution* (1917) is an excellent example. You have

been badly misled by this book; in the first place you have been misled by his assertion in it of the difference between Eohippus and Equus, which, as I have shown (p. 88), he contradicts in his later and more scientific book. He has again misled you by his assertion (p. 70) that 'rudimentary teeth occur in certain embryonic birds which are re-absorbed and disappear before hatching.' Notice he *names no bird nor does he quote any authority!* He was probably casting about for evidence for evolution and remembered having heard somewhere that someone is supposed to have found teeth in a bird embryo, and, without troubling to verify this, he inserted this in his book. Even better evidence that Scott's book is pure evolution propaganda, is the following statement (p. 81), the blood precipitation tests 'come to as near to giving a definite demonstration of the theory (of evolution) as we are likely to find.' This sentence alone condemns the book. One might have expected something better in Scott's *Introduction to Geology*, as he was a professor of that Science, but the passages you quoted in your last letter are unworthy of a place in a scientific book.

The Alleged Transformation of a Reptile into a Mammal.

As you have not told our readers the strange story of how a reptile turned into a mammal I will summarise the version of it given by Dr. R. Broom in *The Mammal-like Reptiles of South Africa* (1932) (p. 320 et seq.) When reading what follows the reader should bear in mind what I said about the differences between reptiles and mammals on p. 164.

'The changes,' writes Broom, 'that converted them or one of them (i.e., an Ictidosaurian reptile) into a mammal may have been a change in diet. The snapping jaw had to be converted into a masticatory jaw, and as the quadrate became more or less fixed to the squamosal (i.e. the bone of the skull on which the quadrate articulates) it kept with it the articular and other little bones of the jaw, and the dentary became comparatively free and formed a new hinge with the squamosal. The small bones, no longer moving with the jaw, became modified as parts of the auditory apparatus. . . . The changes by which the articular became the malleus, and the angular became the tympanic (the bone encircling the ear to which the ear-drum is attached in mammals), in my opinion originated after the small bones had left the jaw, and can be fairly easily imagined.'

In less technical language Broom's story is: Some reptile

scrapped the original hinge of its lower jaw and replaced it by a new one attached to another part of the skull. Then five of the bones on each side of the lower jaw broke away from the biggest bone. The jaw bone to which the hinge was originally attached, after being set free, forced its way into the middle part of the ear, dragging with it three of the lower jaw bones, which with the quadrate and the reptilian middle-ear bones, formed themselves into a completely new outfit. The rest of the lower jaw bones, having no work to do, vanished ! While all this was going on, the Organ of Corti, peculiar to mammals and their essential organ of hearing, developed in the middle ear. Dr. Broom does not suggest how this organ arose, nor describe its gradual development. Nor does he say how the incipient mammals contrived to eat while the jaw was being re-hinged, or to hear while the middle and inner ears were being reconstructed !

The above changes relate only to the skeletal parts of the head and jaw and are insignificant in comparison with the transformations supposed to have taken place in other parts of the body. Let me mention some of these. In addition to the change in the third eyelid, already noticed, the muscle that focuses the eye lost its stripes, and the blood supply of the iris became greatly modified. The mode of locomotion became revolutionised, the thorax became reorganised, the hip bone underwent changes, and the ankle joint shifted to the root of the toes from its original position between the two rows of ankle bones. The whole breathing apparatus was re-modelled, which involved the origin of a new organ—the diaphragm. The transformists who do not believe that this structure can have been developed gradually, deem the mammals to be derived directly from amphibia. A mechanism developed for keeping the temperature of the blood constant, the left aorta was scrapped and the red blood-corpuscles lost their nuclei. The integument became changed beyond recognition ; the scales disappeared and their place was taken by new structures—hairs ; the skin acquired two extra layers ; and three new types of gland sprang into being—the sebaceous, the sweat and the mammary glands. In the wall of the intestine the longitudinal muscles changed places with the circular ones. The chemical changes that take place within the body changed so that the waste products became mainly urea instead of uric acid. In effect the reptile became transformed into an entirely different kind of animal—a new class of animal. If these changes took place as the result of the accumulation of small variations, the

process must have occupied many millions of years, and myriads of intermediate animals must have lived, but not a single fossil has been found of any of them.

The differences just mentioned nearly all relate to the anatomy of the mammals and the reptiles; those in the minute structure of their tissues are equally marked. As Vialleton points out (*L'Origine des Êtres vivants. L'Illusion transformiste*, *p.* 358): 'all the tissues of mammals have their own peculiar characters and there are no transitions between these and those of other vertebrates.'

Despite all this the great majority of evolutionists believe that mammals gradually evolved from reptiles. This is asserted dogmatically in all text-books, taught in universities and schools, and proclaimed by the B.B.C. In the broadcasts to schools the children are told that they are descended from fishes, through reptiles and apes, and near-men, which are described in detail accompanied by the grunts and uncouth sounds made by these imaginary beings. Is it then surprising that our magistrates lament the increase of crimes by juveniles?

A. N. Field truly remarks in his brilliant little book *Why Colleges Breed Communists*: 'Verily the evidential standards of modern evolutionist science represent probably the lowest point in intellectual degeneration reached by civilised man in the past two thousand years.'

Yours sincerely,

D. DEWAR.

DEAR DEWAR,

This is my final letter and very little remains to be done except to say that I have found the discussion interesting in many ways, and am very pleased to have been able to argue the matter with you. I greatly dislike anyone saying that their arguments have been ignored, and that their case has not been fairly considered, and I think it will be agreed that I have tried to understand what you have to say, and to meet it in so far as I have been able to understand it.

The title of this book is: *Is Evolution Proved?* It does not seem to me that there is any reasonable doubt about the answer. The problem that interests me more is what we mean by proved. What kind of proof is possible in a case of this kind? That is a philosophical question which cannot be properly treated in a controversial discussion, and which I cannot deal with here. All I can say

is that I think the proof in a general way is perfectly sound so far as is possible in a case of this kind. When the events concerning which we make assertions occurred in the remote past, it is only indirect evidence that is available.

I have endeavoured to show that this indirect evidence is of the kind and quantity which would naturally be expected. This is dealt with in detail throughout the book, and is summarised in my first letter in this chapter. I do not now propose, nor do I think it necessary, to add anything to that. You and the editor have been very insistent that a discussion of the causes of evolution is a necessary complement. I do not agree about the necessity, but I have done my best to meet you in my last letter—p. 314. Needless to say this is very brief and inadequate, but it does do something to meet your request. It is desirable to repeat —what I said at the time—that this section is theoretical and personal, and not part of the evidence for evolution. Still, considered in that light, I think the points I have brought forward are worthy of consideration.

It is of course not claimed that the evidence for evolution is complete. Obviously it is not. Every fossil discovered which combines characters which were previously only known in different families or orders is additional evidence. Every research in morphology, physiology, or embryology, which shows similarities not previously known between different families or orders is additional evidence. This is continually accumulating from year to year. Of course there are gaps in the geological record, and morphological puzzles. With regard to the latter, I have done a little plausible guessing in the appropriate chapters, and you are not satisfied because I have not done more. I think I have done enough, and in any case am of the opinion that plausible guessing is a futile process, and I have only consented to do it at all because you and the editor attach importance to it. But to continue, and particularly to do anything of the kind in this last chapter, would be tantamount to admitting that it is of some consequence, which most emphatically I do not. With regard to the general evidence for evolution it is of course open for you to say—as in effect you have said—that the evidence is not sufficient *for you*. There is no answer to that, and I shall not attempt to give one.

The discussion has shown quite clearly, what should have been obvious from the outset, that the only conceivable alternative to evolution is special creation. It has become more and more apparent

to me as the discussion proceeded that this is not a scientific question, but belongs to the sphere of private theology. It has not been suggested that there is any direct evidence that a particular form has been specially created at a particular time. Even Colonel Merson Davies, who believes that some lice were specially created quite recently, as recorded in Exodus, would hardly contend that the evidence was sufficient to establish it as a scientific fact. It is recorded in Exodus, and that is sufficient for him. If, on the other hand, you assert that the *direct* evidence for evolution is very slight, which is more or less true, and that, like the evidence for evolution, the evidence for special creation is indirect, you are in an unassailable position. No one can prove that special creation has not occurred, as I showed at the start by an example which greatly annoyed you, and which I will not repeat.

In asserting special creation you are perfectly safe from disproof. Put in special creations when and where you like, and no one can disprove you. As a matter of personal curiosity, I should have liked to have been informed what special creations you thought necessary in the case of the Hominidae ; but that is merely personal curiosity. You allege that it is reasonable to postulate special creations in some cases but not in others. There I disagree and cannot see reasonable ground for postulating them anywhere, though they are more plausible in some cases than in others. If there were agreement what special creations were necessary, we might take you more seriously, but I have not been able to find anything sufficiently definite, much less agreement. Vialleton, according to your account, regards the family as the unit of creation ; you are not sure ; and Davies thinks several special creations probable in the case of the dogs. If you want special creations no one can disprove you, but I cannot see any reason, in science or in theology, why you should want them. That is a fundamental difference between us, and I see no way of getting round it.

The main question of course is not special creation, but to what extent evolution is proved. I have attempted to show that the proof is as complete as can reasonably be expected in the present state of our knowledge, and that it is proved beyond reasonable doubt. To what extent I have succeeded is for the reader to judge.

Yours sincerely,

H. S. SHELTON.

5, Ferry Road, Teddington.

DEAR SHELTON,

The editor writes :- 'Shelton writes "the only conceivable alternative to evolution is special creation." He is wrong. The origin of species may be one of the innumerable insoluble problems (see p. 15). I am only one of many who believe that the difficulties both of evolution and of special creation are so great that the only scientific attitude is to suspend one's judgment. My own lines of research did not encourage me to claim to have solved insoluble problems, perhaps because irresponsible dogmatism about avalanches might lead to more fatal results than irresponsible dogmatism about Archaeopteryx. "No one," writes Shelton, "can prove that special creation has not occurred." He implies that no evidence would shake the faith of the special creationist. The same might be said with more justice of the evolutionist. In fact Prof. D. M. S. Watson has said it ! And it is charitable to assume that Shelton has *forgotten* that you and I have both defined the kind of evidence which we should both regard as completely fatal to special creation (p. 53).

'Influenced as I am by the mental fashion of the day my bias is in favour of evolution and I should accept evolution as proved but for the following facts : (a) the difficulty of reconciling the suddenness with which new types appear in the geological record with any theory of slow mindless evolution, (b) the impossibility of tracing any family into another family by means of a true lineage series of fossils, (c) the impossibility of reconciling the alleged imperfection of the geological record with your statistics which suggest that most genera are represented in that record (pp. 61–71), and, finally, (d) the fact that no evolutionist has produced a plausible *guess*, much less a theory supported by evidence, to suggest how a purely natural process could have evolved from the mud, sand, mists and seas of the primeval planet the brain that conceived Beethoven's Ninth Symphony and the reactions to the beauty of music, of art and of nature.

'Evolution cannot be *proved* by sneering at Fundamentalism. I do not go so far as Lemoine, former honorary Director of the National Museum of Natural History in Paris and editor of the section of the French Encyclopaedia dealing with Evolution, that "evolution is impossible" (see p. 10), but in view of the growing scepticism among scientists (see p. 9) it seems to me that it is a crime against science to allow evolution to be represented in most schools as a proved and demonstrated fact. In a minority of schools

pupils are told the arguments for and against evolution, and are left to make up their own minds. Those who agree that in this respect at least the attitude of the minority is more scientific will be the first to welcome this book, the first of its kind, the first point by point discussion of the case for and against evolution. It seems to me an ideal book to be put into the hands of an intelligent boy or girl. You are both masters of your subject. You have both had a scientific training. You are both skilled advocates and I must congratulate you both on your success in presenting your respective arguments in a fashion which should appeal not only to specialists but also to the public which your editor is anxious to reach, the public consisting of intelligent laymen.'

. . . . .

The inclusion of the above remarks by the editor leaves little more than a page for the rest of this letter. I join in the editor's congratulations on the skill with which you have presented your case. What has made such demands on your skill is that you, as an advocate, have not only to try to prevent our readers from discovering that there is *no evidence whatever that any major group of animals or plants has ever evolved from another*, but you have also to induce them to believe that such evolution has in fact occurred despite the fact that all the facts, as opposed to opinions and theories, it is possible to adduce, indicate at most (what most scientific creationists believe or think probable), that many organisms have in course of time undergone considerable modification *within the limits of the family*.

You have worked these meagre facts valiantly. You believe they show that all the horses are derived from a common ancestor. This being so, you assert that it is mere obstinacy not to believe that all horses, lions, whales, bats, elephants, etc., are not descended from a common ancestor. And to stop at this point is illogical. The sensible man believes that *all* plants and animals are derived from a common ancestor. It is the fashionable belief. Only cranks refuse to join in the general acclamation of evolution. Special creation is a doctrine for fools and muddleheads. You tell our readers that in biology, the ordinary rules of evidence do not apply. The evolutionist has not to prove evolution ; he who rejects it has the task of proving that it has *not* occurred. As to the evidence adduced against evolution, this ought to be brushed aside as useless, because, if accepted, it means that special creation is true, which

no sensible man can possibly believe. We have the choice between accepting evolution or nonsense !

So far as I am aware you are the only evolutionist who has had the courage to debate evolution with a trained biologist. My experience is that, although many scientific biologists proclaim evolution loudly through the medium of the Press and the B.B.C., none of these gentlemen is willing to debate it with another biologist.[1] You, unlike such biologists, have the courage of your convictions, and you deserve the thanks of our readers for giving them an opportunity of becoming acquainted with many facts about evolution that find no place in biological text-books.

Yours sincerely,

DOUGLAS DEWAR.

Almora,
Park Avenue,
Camberley,
Surrey,
October 25th, 1945.

[1] See *Evolutionists Under Fire*, by L. Merson Davies and me. (Copies obtainable from either of us.)

GLOSSARY

(Compiled by H. S. Shelton)

Note.—A number of technical terms, particularly the names of the geologic epochs, are explained in the charts. Others are explained in the Introduction and in the text. This glossary deals with a few others.

ACHEULEAN. See Palaeolithic.

ADRENALIN. A substance manufactured by the suprarenal glands. It has the property of constricting the arteries and stopping the flow of the blood. For this reason it is used with a local anaesthetic in dentistry.

ALGAE. The simplest forms of green plants. The smallest consist of one cell only and are microscopic. Others are multicellular, and some, especially seaweeds, attain a considerable size. All the same they are simple in structure, and in particular the differentiation into roots, stems, flowers, and leaves found in the higher plants does not exist.

ALISPHENOID CANAL. A narrow passage situated in the sphenoid bone at the base of the skull. The sphenoid bone is a wedge-shaped bone situated between the temporal and occipital bones. It separates the upper and back parts of the cavity of the nose from the cavity of the brain. The name is derived from the Greek and means wedge-shaped.

ANDROMEDA. A constellation south of Cassiopeia, which is easily identified by the beginner. The Great Nebula referred to is in the north-eastern section of the constellation, about 16 degrees south and slightly east of Beta Cassiopeia, the bright eastern end star of the five.

AMMONITES. Fossil cephalopoda related to the modern cuttle fish. In the fossils, with other features, ink bags have been found.

ARTHROPODS. A phylum of animals including insects, spiders and crustacea. They are distinguished from other invertebrates by containing about 20 segments which are well differentiated also by the possession of jointed limbs.

AUDITORY BULLA. A portion of the temporal bone of the skull connected with the ear. It covers the bone which contains the ear capsule.

BALANOGLOSSUS. A worm-like creature which lives in the mud of shallow seas. There are a number of species, the length of which varies from an inch to two or three yards.

BRACHIOPODS. A well-known fossil which is in appearance something like a bivalve mollusc (e.g. the oyster), but differs in that the two halves of the shell contain the upper and lower parts of the body respectively, instead of, as in the mollusc, the right and left sides. There is considerable doubt about the classification of this form.

CANINES. The teeth next to the incisors, so called because they are well-developed in the dog, and in carnivora generally. The full complement of mammalian teeth is 44, though in many species some of them are missing. These 44 are of course 22 in each jaw and are similar on

each side of the jaw. They are classified as follows. The three front ones are known as incisors, the next as the canine, the next four premolars and the back three molars—11 in all.

CARPALS. A set of bones in the wrist. The bones in the human arm are known as follows : (1) from the shoulder to the elbow—humerus ; (2) from the elbow to the wrist—radius and ulna ; (3) in the wrist and hand (with some other small bones we need not mention): (a) carpals, (b) metacarpals, (c) phalanges or digits (last three joints). The corresponding bones in the leg are (a) femur, (b) tibia and fibula, (c) tarsals, metatarsals and digits. In other vertebrate animals the bones are similarly named but their sizes and proportions vary, and often some of the bones are missing. In the horse, concerning which the discussion of these bones occurs in this book, the lower bones, such as are there, are greatly enlarged. The knee and hock in the horse correspond to the ankle and wrist in human beings.

CARUNCLE. A small pale red excrescence in the inner corner of the eye.

CEPHALOPODS. A class of molluscs (q.v.) which includes the cuttle-fish.

CHELLEAN. See Palaeolithic.

CHELONIA. An order of reptiles including the turtles and tortoises.

CHROMOSOMES. Rod or thread-like structures in the cell nucleus, so-called because they are more easily stained than the surrounding protoplasm.

CONJUNCTIVA. The membrane surrounding the eyeball.

CRINOIDS (or crinoidia). A class of echinoderms (q.v.) which includes the ocean lilies.

CRUSTACEA. A class of arthropods (q.v.) which, generally speaking, is distinguished from others by a hard horny covering which is periodically shed. The lobster, shrimp and woodlouse are good examples of this class.

DEMIURGE. This term refers to a number of early Christian heresies, one of the tenets of which was that the world was not created directly by the Divine Being, but by an intermediate agent known as a Demiurge. This is set forth at length in the writings of Irenaeus.

DIASTEMA. The gap between the front and back teeth found in a number of mammals, e.g. horses and cattle. More generally—any gap between the teeth.

DIGITIGRADE. A term implying that the animal walks on the toes only, not on the body of the foot, as for example, cats.

ECHINODERMS (or echinodermata). A phylum of invertebrates of which the star-fishes and the sea-urchins are probably the most widespread.

EPIDERMIS. The outer layer of the skin. Adjective—epidermal.

FIBULA. See Carpals.

GANGLION. A swollen part of the nerve system, acting as a nerve centre.

GLYCOGEN. A starch-like substance found in animal tissues. It decomposes to form the sugars which are consumed in vital processes. Sugar, it should be noted, is a generic term, and ordinary sugar (sucrose) is merely one of a number of sugars.

HETERODONT. A term applied to teeth implying that they are of different kinds, as distinguished from homodont, which means that they are all of the same kind. A good example of the latter is the dolphin.

HOMO NEANDERTHALENSIS. See Palaeolithic.

HUMERUS. See Carpals.

LARVA. The immature form of an animal which passes through more than one phase of active existence. The caterpillar is the larva of the butterfly or moth. Adjective—larval.

LINEA ALBA. A band of fibres running along the middle of the front abdominal wall interlaced with the sheaths of the abdominal muscles.

MAMMAL. A class of vertebrates (q.v.) which includes all the ordinary quadrupeds as well as bats and such sea animals as whales and seals. The name implies the existence of mammae or milk glands in the female which enable them to suckle the young. Hair is another structure peculiar to mammals, though some mammals such as whales are practically hairless.

MAXILLAE AND MANDIBLES. Appendages or limbs commonly found in arthropoda. The first act as jaws and the second as a grasping organ.

METACARPALS. See Carpals.

METATARSALS. See Carpals.

MOLARS. See Canines.

MOLLUSCS. A phylum of animals generally distinguished by a hard and rigid external shell which is loosely fitting, as distinguished from the closely fitting one of the crustacea (q.v.). In a number of molluscs the shell is rudimentary. The phylum includes oysters and other shell-fish, snails and slugs, and cuttle-fish.

MOUSTERIAN. See Palaeolothic.

NICTATING LID OR MEMBRANE. The third eyelid which, when functional, is an elastic membrane covering the eye from the inner corner. In human beings and in some other mammals it is rudimentary.

PALAEOLITHIC. The term means in general the period of time in which men, or creatures similar to men, existed and made implements previous to the Neolithic, that is the age of polished stone and of agriculture. The Palaeolithic is divided into a number of sections based on the implements which have been found. The implements are usually of flint, but occasionally implements of bone horn and other substances have survived. The order of the cultures working backwards in time is as follows :

(a) *Upper Palaeolithic.* Azilean, Magdalenean, Solutrian, Aurignacian. A few skulls and skeletons have been found which are invariably similar to those of modern man. The names are usually derived from the district in which the implements are first found, or from those in which they have

been found in unusual abundance. For example the Solutrian culture is named after the village of Solutré, in the Saone drainage area.

(b) *Lower Palaeolithic.* Mousterian, Acheulean, Chellean, Strepyan. The Mousterian culture is mainly found in the last stage (Wurm) of the glacial epoch. The implements were made by Homo Neanderthalensis, which was a different species from modern man, in particular different in the form of the brain, the teeth and generally in the structure of the bones.

Before the Mousterian, again, there is an absolute break in the character of the culture, but the previous cultures : Acheulean, Chellean and Strepyan grade into each other. The exact physical form of the men who made these implements is not known, but it is generally believed that they were much nearer to modern man than is Homo Neanderthalensis, and may well be his ancestors. The last two cultures almost certainly date back to the main interglacial (Mindel-Riss). Before the Strepyan the order of the cultures is not clearly made out. A very considerable time elapsed between the Strepyan culture and the implements found by the late Mr. Reid Moir in the Pliocene.

(*Note.*—The ice age consists of at least four periods of glaciation known as the Gunz, Mindel, Riss and Wurm. These periods were separated by warm interglacial periods known as the Gunz-Mindel, Mindel-Riss and Riss-Wurm. Note the alphabetical order of the names. The Gunz, of course, was the earliest.)

PARALLAX. In general this means the apparent difference of position of nearby objects when viewed from different places. Annual parallax is an astronomical term meaning the (very slight) difference of position of the nearest stars when viewed from different parts of the orbit of the earth.

PARAMECIUM. A complicated microscopic unicellular organism sometimes known as the slipper animalcule from its shape.

PILTDOWN MAN. Otherwise known as Eoanthropus Dawsoni, is named from an incomplete skull found near the village of Piltdown, near Lewes (Sussex). A full account of the details will be found in Keith's *Antiquity of Man.* It is sufficient to say here that the brain is of human size but there are sufficient differences in the character of the skull and jaw to justify the classification of the specimen in a different genus.

PROPLIOPITHECUS. A fossil ape found in the lower Oligocene.

RADIUS. See Carpals.

TRYPSIN. The chief digestive ferment of the pancreatic juice, which converts proteins to peptones.

ULNA. See Carpals.

UNGULATES. Animals having hoofs. This is a very large order of mammals, conventionally divided into a number of sub-orders.

VERTEBRATES. Animals known as vertebrates are distinguished from others by the possession of a jointed backbone. The jointed parts of the backbone are called vertebrae. The five classes of vertebrae are fishes, amphibia, reptiles, birds and mammals. The vertebrae, particularly in

mammals, are classified as : cervical (those in the neck), dorsal or trunk (those in the back), sacral (those which are fused to form a support for the hind limbs), and caudal (in the tail). The sacral vertebrae are sometimes called the sacrum.

Animals not vertebrates are sometimes called invertebrates, but they are divided into several phyla, e.g. mollusca, arthropoda, etc. (q.v.).

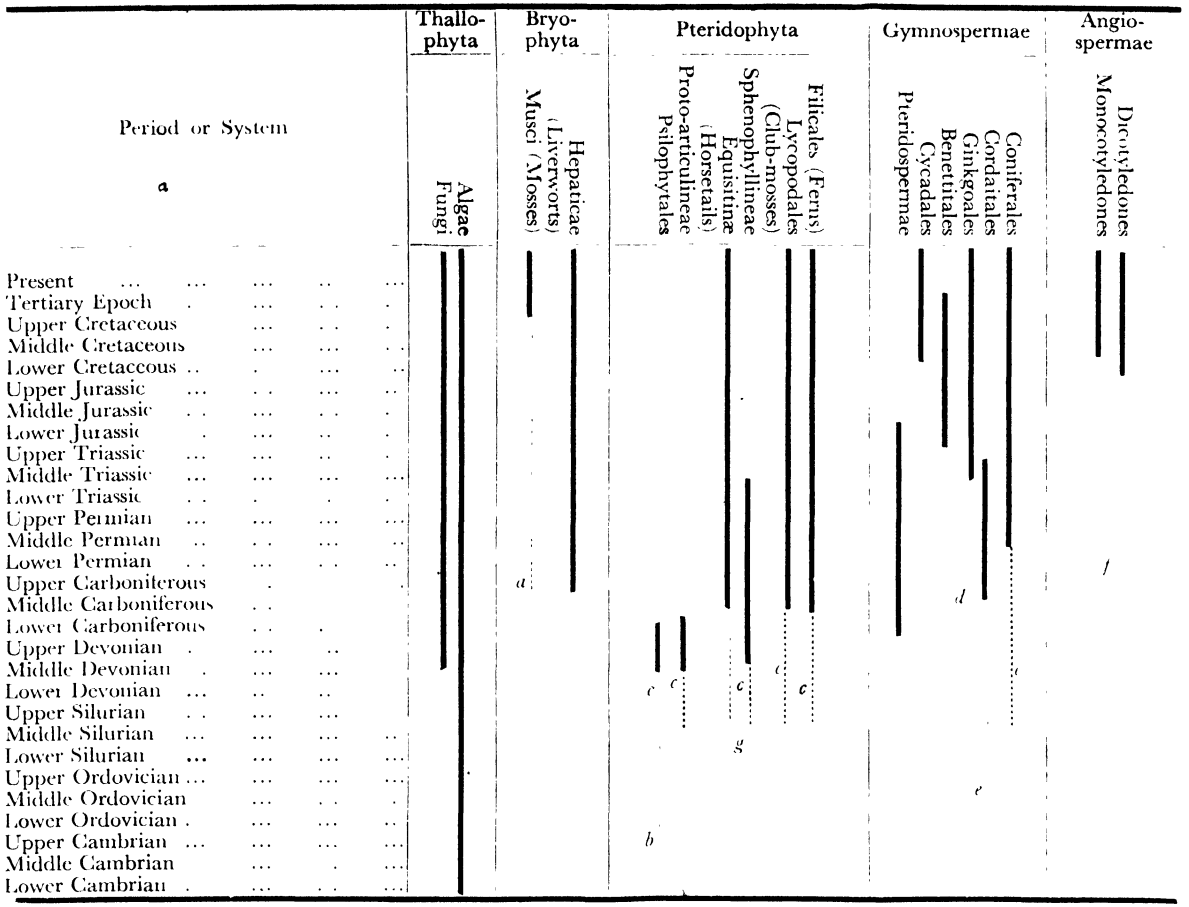
VIVERRIDAE. The family of carnivora which includes the mongoose and the civet cat.

VORTICELLA. A microscopic unicellular organism, sometimes called the bell animalcule from its shape. It has a long stalk at the end of which is the principal part of the living organism, which is shaped something like a bell.

(Reproduced from the *Journal of the Transactions of the Victoria Institute*, vol. LXXVI, 1944)

CHART II OF THE GEOLOGICAL RECORD

Periods during which the classes of plants are known to have existed.



NOTES ON CHART II

(*a*) Some authorities deem *Muscites polytrichaceus* and *M. bertrandi* from the Upper Carboniferous deposit in France to be Mosses.

(*b*) W. C. Darrah found a fossil in a Cambrian deposit in Sweden which he considers to be the shoot of a land plant.

(*c*) Fossils of Psilophytales, Equisitinae, Sphenophyllineae, Cordaitales and Filicales occur in the Fern Ledges of New Brunswick, (See note (*b*), Chart I.)

(*d*) *Psygomophyllum* from the Upper Devonian of Bear Island may be the impression of the leaf of a Ginkgo.

(*e*) Fossils *Dadoxylon hendricksi* occur in deposits in Cornwall deemed to be Upper Ordovician and Lower Devonian by the Geological Survey.

(*f*) The fossil *Angiospermum americanum* from a Carboniferous deposit in the U.S.A. is held by its discoverer, Dr. Noe, to be part of the stem of a monocotyledonous flowering plant. Seward and others consider it to be that of a Pteridosperm very like the Maize plant.

(*g*) The fossil *Buthotrepis harknessi* found in an Ordovician deposit in England is deemed by its discoverer, Nicholson, to be a sea-weed, but Sir J. Dawson considers it to be an Equisetum and he changed its name to *Protoannula harknessi*.

That six Classes of plants have become extinct as opposed to only two of animals may be ascribed to the fact that the sea is less affected than the surface of the earth by climatic changes resulting from geological disturbances.

INDEX

A

Acanthodii, 111
Achatinellinae, 142
Acila, 131
Adam's Apple, 209, 214, 220
Adaptis, 123
Agassiz, 74
Agriotes, 179
Allotheria, 123
Alytes, 247
Ambi-neuter postulate, 17–19, 29
Amblypoda, 123
Amblystoma, 145
America, South, fauna, 142, 143, 290, 294
Amphibia, distribution of, 141, 145, 293–4
Amphioxus, 203, 211
Amusium, 131
Antedon, 296
Aponeurosis, epicranial, 234
Aquinas, Thomas, 4, 16
Arachnecthra, nest of, 239, 245
Arca, 138, 152
Archaeornis, 74
Archaeopteryx, 74, 77, 105, 106, 108–14, 119, 127, 135, 157, 168, 170, 174, 201, 297, 333
Ardt, 259
Argyroneta, 241, 244, 246
Arsinotherium, 123
Atrina, 131
Augustine, St., 114
Australian fauna, 140, 142–3, 148, 293–4, 307
Azores fauna, 143, 145

B

Baer, von, 201, 203
Backbone, development of, 207, 211, 216, 220
Baikal, Lake, fauna, 143
Balanaglossus, 167
Barrett, 122
Bateson, 188
Bats, early, 127
B.B.C. and evolution, 2, 300, 330, 335
Beauty, sense of, 22, 34, 43
Beebe, 258
Beer, de, 88, 117, 219
Bellinuridae, 296
Berg, 21, 111
Bessel, 297
Black, 271
Blood-vessels, development of, 207 et seq., 212, 214, 220
Blyton, 20, 33
Boskop skull, 265
Boule, 270, 171
Brachiopod fossils, 78, 80, 306
Branchial arches, 202, 207–9
Broca, 5
Brooks, 120
Broom, 259, 261, 267–8, 275, 328, 329
Brown, Father, 115
Bryant, 126
Bufo, 248
Buffon, 4
Bullen, 181
Burial, intrusive, 273, 277, 279, 282
Butler, Bishop, 12
Butler, S., 2
Butterflies, swallow-tailed, 146
Buxton, 259

C

Calaveras skull, 253, 268, 272–3, 304
Camels, 77, 100, 104, 140
Canidae, 104 et seq.
Cats, 85 et seq., 94, 112, 116, 156, 289, 314
Carazzi, 279
Castenedolo skull, 254, 268, 270–6, 304, 312–3
Celebes fauna, 141
Cephalogale, 97
Cetacea, 127–8
Chaeropotamus, 124
Chambers, 67
Chesterton, 271
Chromosomes, 191, 318–9, 325
Civets, 85 et seq., 298 et seq., 313 et seq.
Clark, A. H., 8, 51
Clark, le Gros, 259
Clark, R. E. D., 325
Classification, 3, 154 et seq.
Clichy skeleton, 269
Click beetle, 179, 182, 304
Clothes moth, 249
Club, missing-link, 270
Coecilians, 145
Corti, organ of, 164, 178, 283–4, 304
Creodonts, 123
Crepis, 192
Crocodilus, 147
Cro-Magnon man, 264
Crookshank, 259, 275
Cryptoprocta, 300, 313–5
Cuénot, 88, 180, 313
Cuvier, 119, 124
Cynodictis, 97, 101, 104, 109, 113
Cynognathus, 105, 109
Cyrtopinna, 131
Cystignathidae, 145

D

Dames, 110
Dante, 166
Darwin, Charles, 21–6, 34, 36, 43, 45, 58, 67, 136–9, 201, 237, 252, 255–9, 303, 318
Darwin, Erasmus, 4
Davies, L. Merson, 51, 267, 290, 325, 332, 335
Davies, Morley, 2, 26, 222, 237
Dawson, 8
Dean, Bashford, 177
Delage, 6, 51
Dendrobatidae, 145
Depéret, 51, 110
Dermophis, 145
Design in nature, 6, 248, 250, 322, 325
De Vries, 316, 317
Diamare, 278
Dicotyledons, 111
Differentiation, 218
Diplodocus, 111
Diversification, 218
Dogs, 187, 189, 196, 267
Drosophila melanogaster, 187–8, 192, 197, 223
Drosophila pseudo-obscura, 190, 193
Dubois, 270–1
Du Toit, 151
Dwight, 8, 252, 272

E

Ear bones, 164, 328
Echidna, 206
Elephant, 97, 101, 104
Embryology, 199–221, 294, 309–10
Entropy, 27
Eoanthropus, 275
Eohippus, 51, 83 et seq., 299–304, 313–4, 321, 326–7
Epihippus, 83
Epiglottis, 208, 214, 220
Equus, 56, 81 et seq., 299–304, 313–4, 321, 326–7
Eutermes, 147
Evolution, atheistic, 14, 30, 322
Evolution, causes of, 25–56, 99, 101, 103, 315–24
Evolution, deistic, 14, 41, 322
Evolution, polyphyletic, 38, 53, 55
Evolution, theistic, 14, 41, 322
Experimental evidence, 186 198, 308, 309
Eye, origin of, 21, 34, 44, 235, 292
Eye, development of, 211

F

Fabre, Henri, 241
Fano, G., 249
Feathers, origin of, 20, 33, 44, 49, 119, 178, 181, 183, 234–6
Felichthys, 248
Field, A. N., 330
Fishes, early, 126
Flat-fish, eyes of, 204, 211
Fleming, 8
Flight, nature of, 174–5, 181, 183
Flowerpeckers, 148
Flying fishes, 176, 181, 184
Flying squirrel, *see* Squirrel
Fold, semi-lunar, 224, 226, 228, 280–4
Folsom culture, 277
Foxhall jaw, 269
Froude, 27

G

Galapagos Islands, birds on, 142
Galley Hill, skeleton, 269, 274, 279, 281, 284, 304, 312, 314
Gaudry, 327
Geikie, 73, 122
Genera, extent to which fossilised, 61–63, 71
Genera, long-lived, 130
Genera, stable, 147
Genes, 186, 190, 197, 235
Geographical distribution, 138–153, 293–4
Geological record, content, 81–138
Geological record, value, 57–80
Goldschmidt, 192, 197
Goodrich, 224, 226
Goose-flesh effect, 226, 229, 231, 318
Gorilla, 278
Gosse, 12, 18, 30, 115
Gregory, S. W., 122
Gregory, W. K., 259
Gymnodactylus, 147

H

Haacke, 259
Haeckel, 195, 258, 259
Hair, body, 224, 226, 229, 231, 255, 326
Haldane, J. B. S., 117, 162, 166, 229, 325
Hartmann, 257
Hawkins, 244, 248, 296
Heart, development of, 207, 209, 214
Heidelberg jaw, 265, 267
Hesperopithecus, 270
Hinnites, 131
Hipparion, 83, 97, 98
Hippidium, 83
Hit-or-miss phenomena, 234, 239, 245, 249, 311, 324
Holmes, A., 36, 149, 151, 170
Holmes, W. H., 253
Homo neanderthalensis, 264–6, 340
Hooten, 272, 277

Hopkins, 196
Horse, definition of, 93, 99, 102
House-martin, nest of, 240, 243, 249
Hrdlicka, 277
Hubrecht, 259, 269
Huxley, Julian, 197, 223, 228, 248, 303
Huxley, T. H., 4–6, 16, 27, 50–1, 63, 108, 122, 194, 257, 291, 302, 313
Hyracotherium, 83, 96, 124, 327

I

Ichthyosauruses, 127
Intermediate fossils, lack of, 127, 128, 253
Instincts, 239–251, 311
Isotomurus, 145

J

Jacobson, organ of, 280
Jepson, 60
Johnson, 254
Jones, F. Wood, 258, 269, 278, 321

K

Kanam jaw, 269
Keith, 1, 7, 177, 216, 253–4, 259. 263, 270, 273–5, 279, 284–5, 312
Kerr, Graham, 213, 221
Kellogg, 21
Kelvin, 36
Kidney, development of, 209, 212, 220
Kingfishers' nests, 246
Kingsley, 18, 31, 125, 144
Klaatsch, 260, 269
Kurz, 259
Krause, 326

L

Lady of Lloyds, 265
Laing, S., 253
Lamarck, 4
Leakey, 259
Leda, 138, 152
Le Dantec, 187
Lefèvre, 90
Lemoine, 9, 99, 102, 333
Letchworth, 280, 282, 283
Levett-Yeats, 2, 61, 69
Life, origin of, 32, 37, 43, 114, 194
Limulus, 296
Lineages, fossil, 13, 31, 81–4, 90, 97, 100
Lineages, parallel, 131
Linnaeus, 155, 193
Liopelmidae, 145
Lithophagus, 131
Litopterna, 159
Llama, 97, 140
Long-lived genera, 129 et seq.
Lophiodon, 124
Lydekker, 30, 81, 86–7, 103

M

Macacus, 327
Macbride, 179
Macfie, 5
Macraphorna, 74, 76
Mammals, origin of, 164, 168, 171, 304
Mammals, statistics of fossil, 61–3
Man, origin of, 252–283, 311
Marsh, 88
Marsupials, 98, 123, 142, 148, 159
Matthew, P., 4
Mayr, 146
Mendeléef, 183
Mendelian laws, 316, 318
Merychippus, 82, 91, 97, 200, 320
Mesohippus, 82, 91
Miacidae, 123
Micraster, 100, 135, 316
Micropternus, 246
Midwife toad, 247
Miracles, 41, 53, 115, 287
Mivart, 149, 252, 260, 314
Modiolus, 131
Moir, Reid, 266, 274
Molluscs, statistics of fossil, 71, 138
Monotremes, 123, 206
Morgan, 206
Morgan, T. H., 9
Morphological characters, distribution of, 61–3
Morphology, 154 et seq.
Morton, 259
Müller, Max, 252
Murphy, 258
Muscles, alleged useless, 233–4, 281
Muscles, simian, 264, 272
Mustelidae, 123

N

National Museum, Paris, 9, 333
National Museum, United States, 60
Natural History of Creation, 67
Natural History Museum, 75, 94, 96, 97, 292, 300
Nature, 24, 74, 90, 190, 193, 195, 268
Nebula, 37, 337
Needham, J., 248
Nematoda, 47
Nephridium, 209
Newton, I., 262, 292
New Zealand, 140, 143, 293
Nilsson, H., 186, 187, 191, 192, 197
Nineteenth Century and After, 4, 228, 255
Notochord, 203

Noyes, A., 22
Nucilidae, 131

O

Obsessions of Biologists, 325
Oligocene, 66, 82, 87, 97, 113, 275
Omphalos, see Gosse, P.
Onager, 93
Ordovician, 71, 75, 77, 130, 138, 151, 154, 162, 167, 170
Origin and Evolution of Life, 24
Origin of Life, 32, 37, 38, 43, 114, 157, 193, 194
Origin of Species, 5, 22, 43, 58, 157, 158, 177, 201, 222, 253, 255 (See also Darwin, Charles)
Orohippus, 83, 84, 90
Osborn, F., 8, 15, 86, 95, 260, 269
Owen, R., 96, 112, 116, 117, 121, 123, 124, 135, 138, 139, 327
Oxford Dictionary, 99, 102, 184
Oxford and Cambridge Review, 27

P

Palaeocene, 63
Palaeodiptera, 134
Palaeodiscus, 296
Palaeotherium, 91, 124
Paley, W., 4, 7, 119, 193, 322
Pancreas, 160
Parahippus, 82
Parallax, annual, 291, 297, 340
Paramoecium, 230, 235, 237, 340
Paranthropus, 267, 270
Parasites, 320
Parsons, F. E., 252
Pasteur, L., 36, 37, 45, 46
Peacock, 23
Pectenidae, 131
Peripatus, 201
Peroneus tertius, 263
Phalanger, flying, 49, 51, 174, 181
Phylum, or Phyla, 2, 3, 39, 46, 47, 92, 101, 119, 128, 136, 149, 154, 158, 162, 167, 169, 201, 206, 215, 218, 292, 341
Physical Geology, 36, 151
Pilgrim, 259
Piltdown Man, or Eoanthropus, 65, 265, 275, 340
Pinnidae, 131
Pinnipedia (seals), 127, 128, 176, 293, 308
Pithecanthropus, 254, 260, 265, 268, 270, 275, 278, 282
Pitt, Miss F., 156
Platyhelminthes, 47
Platypus, 77, 233
Pleistocene, 60, 63, 66, 93, 275, 283
Plesianthropus, 267, 270, 271
Plesippus, 82
Pliocene, 63, 66, 71, 81, 82, 91, 97, 130, 147, 253, 254, 265, 266, 274, 276, 280, 312, 340
Pliohippus, 82, 320
Polydontophis, 146, 150
Polyphyletic Evolution, 38, 53, 55
Polyzoa, 48
Porto Santo rabbit, 189, 192, 196
Post-anal gut, 217, 294
Pre-Cambrian, 120–125, 132, 136, 296, 324
Premises, 28, 29
Primitive Man, 256
Proceedings Aristotelian Society, 1
Procyonidae, 85
Propliopithecus, 65, 259, 340
Protozoa, 47, 130, 147, 148, 149
Pterodactyls, 58, 127
Pulmonata, 69
Pyramidalis muscles, 281, 283

Q

Quarterly Journal Geological Society, 244
Quarterly Review of Biology, 244

R

Racoon, 84
Ragazzoni, 254, 276
Rationalist Annual, 325
Raymond, P. E., 121
Reinke, 15, 273, 300
Reptilia, or Reptiles, 48, 113, 149, 155, 156, 157, 164, 168, 170, 215, 288, 304, 329, 340
Rhinoceros, or Rhinocerotidae, 84, 100, 104
Rosenmuller, organ of, 224
Rowe, A. W., 96
Ruminants, 97, 101, 144

S

Sacrum, 157, 341
St. Francis, (Assisi), 261
St. Helena, 140–2
Sabatier, 5
Sandwich Islands, 142, 147, 148
Schiller, F. C. S., 180
Science and Common Sense, 24
Science of Life, 34, 42, 82, 223, 225, 226, 228, 229, 230, 232, 233, 236, 237, 270
Science Progress, 1, 36
Schlosser, M., 126
Schrodinger, E., 191, 198
Scott, D. H., 8
Scott, W. B., 60, 88, 91, 92, 94, 107, 126, 147, 189, 196, 213, 219, 221, 327, 328
Schultz, 259
Scrofularia, 233

Scymogathus, 105, 109
Seals, *see* Pinnipedia
Sebaceous glands, 229, 231
Seeley, J. R., 123
Sera, 260, 269, 275, 276
Sergi, S., 269
Seward, A., 15
Shaw, G. B., 4, 37, 286, 287
Sidgwick, A., 180
Silurian, 71, 75, 77, 126, 131
Simpson, G. G., 60
Sinanthropus, 254, 266, 270, 271, 275, 278, 282
Sirenia, Sea-Cows, e.g. Manatee, 128, 168, 184
Smith, Eliot, 271
Snails, 155, 306, 339
Snakes, 151, 201, 213, 217, 221, 233, 234, 295
Somites, 158
Spencer, Herbert, 41, 112, 119, 157, 158, 318
Spengler, O., 9
Squirrel, flying, 49, 51, 142, 170, 174, 176, 184
Spiders, 45, 126, 134, 178, 182, 235, 243, 250, 304
Stray dog, 12, 29, 115
Strepyan, 274, 279, 284, 340
Sunbird, 239, 246
Swanscombe Skull, 265, 285
Systematics and the Origin of Species, 146

T

Tailor bird, 246, 288
Tapirs, or Tapiridae, 84, 93, 97, 100, 104, 124, 140, 147, 150, 151
Tautomerism, 317
Testut, 284
Theistic Evolution, 14, 41, 48, 322
Theology of Evolution, 5
Theophobia, 6
Theory and Practice of General Science, 1
Thomas, (St. Aquinas), 16
Thomas, M., 126
Thompson, W. R., 7
Thompson, D'Arcy, 88, 89
Thoughts of a Catholic Anatomist, 24, 252, 260
Tortoises, 134, 137
Triassic, 39, 71, 105, 130, 131, 137
Triassochelys, 137
Trypsin, 158, 340
Tritylodon, 123, 126, 135, 137
Turtles, 127
Tycho Brahe, 241
Tyrell, G. N. M., 230

U

Ungulates, 86, 340
Unknown God, the, 22
Uranus, 43
Ursidae, bears, 97, 123

V

Vanadium, 158
Variations of Animals in Nature, 190
Venom, snake, 38
Vera Causa, 19, 31, 32, 54, 323, 325
Vermes, 130
Vertebrates, or Vertebrata, 48, 130, 136, 154–7, 162, 172, 202–4, 208, 209, 215, 262, 338
Vialleton, L., 13, 51, 87, 88, 90, 94, 98, 110, 117, 118, 165, 174, 177, 183, 184, 200, 213, 214, 217, 218, 230, 232, 244, 255, 256, 278, 330, 332
Victoria Institute, Transactions, 267, 325
Viverridae, and Viverra, 97, 101, 104, 109, 113, 126, 300, 314, 341
Von Baer, 203
Von Euxhill, 6
Vorticella, 230, 341

W

Water spider, 241, 244, 288, 322
Wadjak skull, 269
Wallace, A. R., 15, 27, 41, 48, 139, 142
Watson, E. L. G., 247
Watson, D. M. S., 6, 40, 43, 51, 118, 248, 335
Wegener, K., 151, 152, 293
Weidenreich, 271
Weismann, A., 6
Wells, H. G. and G. F., *see Science of Life*
Westenhofer, 269
Wetterhorn, 22
Whales, 58, 127, 159, 165, 181, 204, 237 243, 292, 307
What is Life? 191
Whelks, 155
Whitehead, A. N., 20, 32, 33
Wiedersheim, 233, 281
Woodlouse, 155
Woollard, H. H., 272
Woolf, 21

X

X-rays, 192, 195, 197, 198

Z

Zebra, 81, 93, 102, 133
Zeuglodon, 134, 165
Zeuner, F. E. 146
Zittel, and Zittel's *Palaeontology*, 109, 123 133, 134, 201, 213, 238, 296

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By

WILLIAM JENNINGS BRYAN

The Bible and Its Enemies

An Address delivered at the Moody Bible Institute of Chicago

By

WILLIAM JENNINGS BRYAN

THIRD EDITION

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The Bible and Its Enemies

INTRODUCTORY

I ESTEEM it a privilege, as it is a pleasure, to appear before an audience assembled under the auspices of the Moody Bible Institute. Mr. Moody was one of the greatest preachers whom it has been my privilege to hear. I heard him when I was a young man in college and I heard him afterwards. I never lost an opportunity to hear him. I have often referred to him as an illustration of how God can infuse into man spiritual power. I have had him in mind as I have pointed out that it is only when you have the measure of a man's spiritual power that you have the measure of the man.

Measure a man in units of horsepower and he is not as strong as some of the animals; measure him in units of intellectual power and you will soon reach his limitations; but measure a man in units of spiritual power and there is no way of telling what a human being can do. Mr. Moody gave us one of

the greatest exemplifications of what a man can do when he loves God with all his heart and with all his soul and with all his mind and with all his strength, and loves his neighbor as himself.

The very fact that Mr. Moody's name is attached to this institution is in itself an inspiration, for it turns our thoughts to him. In him we find what one man can do, and we know that it was not a personal thing with him, but that God worked through him. He can work through any one who will yield himself up and be willing to be used.

I have taken the spring as the best illustration of the Christian life. The stagnant pool receives contributions from all the sloping ground around and gives forth nothing in return. The pool not only becomes the center of disease and death, but it is the most repulsive thing in the world, except a life that is built upon that plan.

A spring, on the other hand, is the most inspiring thing in the world, except a life that is like a spring. A spring just pours forth that which is refreshing and invigorating.

There is a very simple difference between a spring and a pool. A *spring is a spring because it is connected with a source that is higher than itself,* and the measure of the

power that forces the water out is the height of the reservoir above the spring. The quantity that may come from a spring is measured by the quantity in the reservoir above, and the size of the opening.

I have described Christ's mission—not its purpose, but one of its *results*—by saying that Christ takes human beings and brings them into such vital, living contact with the heavenly Father that the individual becomes the means through which the goodness of God pours out to the world. He can take the frailest of human beings and make them infinite in their usefulness, conduits through which He bestows blessings upon mankind. I regard Mr. Moody as a conduit through which the love of God poured out to a world in inexhaustible quantities. There was no selfishness in him to retard the flow of God's love through him.

This morning I shall talk to you on "The Bible and Its Enemies," first expressing my gratitude to Doctor Gray for giving me this opportunity. I am so much interested in this work that I do not need any thanks. On the contrary, I thank people if they are patient enough to listen to me while I call attention to what I regard as a real menace, not only to the church, but to civilization as well.

I make a great many speeches on many different subjects, but there is a sameness about them all. I try to use different illustrations, and possibly if one has not analyzed them he might think they were quite unlike. I have used this illustration: Every part of the rim of a wheel is supported by a spoke that leads down to the hub; the wheel would be nothing but for the hub. So with my speeches: though they have touched the circumference of the wheel at many points, there has always been a spoke leading down to the hub, and that hub is the creed of Christ. Whether I speak on politics, on social questions, or on religion I find the foundation of my speech in the philosophy of Him who spake as never man spake—a philosophy that fits into every human need and furnishes the solution for every problem that can vex a human heart or perplex the world.

OUR BIBLE

Of course, we get all we know of Christ out of this Bible, and therefore I take as my subject this morning "The Bible and Its Enemies." In this Institute I need not dwell long upon the Bible, and yet I venture to give you an argument in favor of this Bible that

occurred to me on the train one day. Opening my Bible I read a very familiar passage, and it suggested an argument that had not occurred to me before. It was the passage which describes Elijah's prayer test. You remember that he challenged the prophets of Baal to call down fire from their god, and he was willing to risk all on that—the God who answered with fire would be worshipped as the true God.

It suggested to me that we who believe in the Bible might well put to the test those who reject it. The Bible is either the Word of God or it is the work of man. Nobody can reject it except on the theory that it is the work of man. Let us ask those who believe that the Bible is the work of man to put their theory to the test. *If it is the work of man, then man can make today as good a book as the Bible, unless man has degenerated.* I will make it stronger than that. If this book is the work of man, man ought to be able to make a *better* book today than the Bible; for if this is so, it is the work of a few men and they were of a single race: they lived in a little district, not larger than a county, on the hills of Palestine. They had no great libraries to consult, no universities to attend, no swift ships to carry them to distant centers of civilization, no telegraph

wires to bring the news from every corner of the earth. Very limited means of information they had when they made this Bible (if it is a man-made book), and yet they dealt with every problem that confronts mankind, from the creation of a world to life beyond the grave. They gave us a diagram of life and set up warning signs at every dangerous point.

This Bible has come down to us throughout the centuries, and what do we find? We find that along every line except the one of which the Bible treats there has been marvelous progress. Take the mastery of the human mind over the forces of nature. Will you suggest a ratio that will describe the advance of the present day over the days when the Bible was written? It has been a long while since the flapping sail whispered its secret of strength to man; since that time man has been using this same idea —the value of the wind as a motive power. We use it to turn the wheel at the well, and now we have taken possession of the air—our ships vie with the birds.

Throughout the ages water came tumbling down the mountainside, useless in its fall to man, but we finally found that its fretting and foaming was just its way of trying to tell us how anxious it was to serve

mankind. Then we found a machine that would turn the weight of falling water into an energizing force. Now when we see a waterfall we measure it in units of horse-power.

The lightning flashed through the skies, an object of terror until some one was bold enough to reach up and bring it down: now we imprison it in a tiny wire and use it to light our homes and draw our traffic across the land. Man has taken possession of the hidden forces of nature and made them to do his will.

But the line of which the Bible treats is the one line along which we have made no progress. That is *the Science of How to Live.* We go back to the Old Testament for the foundation of our statute laws, and we find in the Sermon on the Mount the rules that govern our spiritual development.

We believe that this Bible was by inspiration given. Let those who say this Book is not of divine origin put their theory to the test. Let them gather their best, not from a single race or section, but from every race and clime. Let them take these selected few and give them the advantage of all the libraries and all the colleges, and then let them give the world a book to take the place of this Bible of ours. If they cannot do it,

they must admit either that our Book comes from a source higher than man, or that nineteen centuries of civilization have so dragged us down that man cannot be expected to do today what man could do then.

Will they accept this challenge? No; they will take the Bible and look through it to find some words or phrases or sentences that they can construe as contradicting some words or phrases or sentences somewhere else.

We give this Bible to all as a book good always and everywhere—a light to our feet when we are young—a guide to our path during mature years, and when we come to die, it is the only book one cares to have beside him. No matter what books have interested us in the full flush of life—fiction, poetry, history, science, no matter what—when the darkness comes and the clouds gather, then if our own eyes have grown too dim to read, we pray that there may be some loved one near to bring to us consolations from the Book of Books.

"The Lord is my shepherd; I shall not want. He maketh me to lie down in green pastures: He leadeth me beside the still waters. He restoreth my soul: He leadeth me in the paths of righteousness for His name's sake. Yea, though I walk through the valley of

the shadow of death, I will fear no evil: for thou art with me; thy rod and thy staff they comfort me." This comes to us from the Old Testament, and from the New Testament: "I go to prepare a place for you, that where I am, there ye may be also."

This is the Bible that the Christian world believes in. This is the Bible that for nineteen hundred years has been increasingly the basis of thought and of progress. I must now speak to you of the enemies of this Bible.

THE AGNOSTIC

In the first place, there is the Agnostic—the one who says that he *does not know whether there is a God or not.* It is hard to be patient with a full grown man who can not form an opinion on this subject. It is hard to believe that a man who can form opinions on such small evidence on everything else cannot reach a conclusion on this subject with evidence so overwhelming. And yet there are some who say that they do not know. If they find a broken bowl in an Indian mound they will estimate the civilization of the tribe that made it, but they are blind to the evidences of design written on all the handiwork of the Creator.

If it is hard for any one to believe in a God, it is still harder to explain the universe, nature and man with God left out.

When a young man, I wrote to Colonel Ingersoll and asked him for his views on God and immortality. He was the leading infidel of his time, and traveled over this country shaking the faith of Christians as far as he could. I received a letter from his secretary saying that Colonel Ingersoll was not at home, but enclosing an extract from a speech of Ingersoll's that gave his views. This is what I read: "I do not say that there is no God: I simply say, I do not know. I do not say that there is no life beyond; I simply say, I do not know." And from that day to this I have asked myself the question —and have never been able to answer it to my own satisfaction—how could anyone find pleasure in taking from a human heart a living faith and putting in its place the cold and cheerless doctrine "I do not know"!

Such a man cannot tell you much. A man must have knowledge before he can impart it, and he must believe before he can advise you what to believe.

Some who call themselves agnostics are really atheists; it is easier to plead ignorance than to defend atheism.

THE ATHEIST

Next, the Atheist. I have met only two in all my life, and I have been meeting people for a long while: two atheists constitute the whole number that I have *met.* I had a letter from one. He said, "I am an atheist, but I think that to be happy one must believe in God." Do you call that a laughable thing? If you want to know how serious it is, read the words of George Romanes, who went to college a believer in the Bible and in God and in Christ and who was led so far away from his belief by Evolution that he wrote a book in which he combated the idea that there is a God. Let me read you what he wrote in that book: it is most pathetic.

When he had reasoned himself into an atheistic position he stated his disbelief in God, and then says: "I am not ashamed to confess that with this *virtual negation of God* the universe to me has lost its soul of loveliness, and that from henceforth the warning to 'work while it is day' will gain an intensified force from the terribly intensified meaning of the words that the 'night comes when no man can work.' Yet when I think—as at times I must—of the appalling contrast between the hallowed glory of the creed that once was mine and the lonely

mystery of existence as I now find it, I feel it impossible to avoid the sharpest pang of which my nature is susceptible!"

He went out into a starless night. While he felt that he must, in obedience to his exaggerated confidence in his reason, deny the existence of God, he was not ashamed to confess the appalling contrast between the glory of the creed that once was his and the lonely mystery of existence as he found it.

I have met some who have been atheists and have been brought back to God. The bright spots of my life are the days in which I learned that I had been a help in bringing men back to God. I traveled from Washington to Kansas City some years ago to speak at a missionary conference. A few weeks afterwards I received a letter from a lawyer who said that he went to that conference an atheist, had been converted, and had since his conversion brought seventy into the church.

In Florida a man and his wife were in a meeting; the wife called soon afterward to tell my wife that her husband had been an atheist, that he became interested in what I said and in the night woke her up to say that he had been converted, declaring that he had been wrong all his life. There is more happiness in bringing souls back to God than in presidential nominations.

THE "HIGHER CRITIC"

I am not worried, however, about the man who declares that he is an atheist. He is like one who blows out the light. I know what he has done and I can light it again and express my opinion of the person who blew it out. But suppose he comes up and says, "I beg your pardon: I am afraid that light is so near you that it will hurt your eyes." He then moves it back, and back, until finally I do not see the light at all. That is the man I am afraid of.

The Higher Critic moves the light away, a little at a time, and finally takes it out of sight. There are some honest friends of the Bible who count themselves Higher Critics. These are trying to make the Bible suit the men who are criticizing it. But a head is worth little except to find reasons for doing what the heart wants to do. "Out of the heart are the issues of life." The mind can find an excuse for doing anything that a wicked heart wants to do. The Higher Critics who are trying to please such men are attempting the impossible task of suiting the Bible to a skeptical brain. The brain that is controlled by a heart that has love and faith in it does not need to be converted to the Bible—and no other kind can be converted to

it. If I understand the average Higher Critic, he is an egotist who thinks himself above the Bible and looks down upon it. He puts the Bible upon an operating table and cuts out what he regards as the diseased parts. When he gets through, the Bible is no longer the Book of Books; it is just a "scrap of paper."

The Higher Critic does not think of the survival of the Bible—it is a successful surgical operation if it takes out everything that he does not believe in. He does not act like a physician who is trying to understand anatomy in order to apply healing remedies; he is rather like the assassin who examines the body to find the place where a blow will be fatal.

You know of cases where this Higher Criticism has kept men out of the ministry, and it also leaves in the ministry men who ought to get out. The men who are tinctured with Higher Criticism ought to get into contact with nature and nature's God; they might come back after a while and do some good. Paul Kanamori, "the Japanese Billy Sunday," was so misled by Higher Criticism that he gave up preaching for twenty years. In the five years since he repudiated Higher Criticism he has brought 48,000 souls to Christ. In southern Ohio within three months one of these men told

his Sunday-school class that Christ was a bastard. He is not preaching in that church any more. He had to go to some other place where he can believe that, but he will probably be discreet enough there not to tell anybody.

But while few men are brazen enough to call Christ a bastard, that is exactly the belief of most of the Higher Critics, many of whom teach in our colleges. I read a book recently written by a professor in a Methodist college; when he came to miracles, his position was that our belief in a miracle should depend upon whether (in our judgment) there was reason sufficient to justify the performance of a miracle. As the resurrection was needed to establish Christ's authority, he thought it was worth while to perform that miracle, but he did not think there was a sufficient reason for the virgin birth, and so he rejected it. Think of such teaching in a Christian college! Most of them say they do not believe in the virgin birth, and yet the virgin birth is no more mysterious than our own—it is simply different. A God who could create by one method could create by the other also. They go through the Bible and reject everything they do not think reasonable. If we have to have a bible that seems reasonable to *every* man

who reads it, we must have a good many different kinds of bibles to fit the different reasonings of different people—and of the same people at different times. It must at last be brought down to the mind that can least comprehend the Infinite.

The Higher Critic usually feels little interest in revivals—he calls them "religious spasms." He recognizes that a man can have a spasm of anger and become a murderer, a spasm of passion and ruin a life, a spasm of dishonesty and rob a bank, or a spasm of appetite and die of delirium tremens, but cannot understand how one overwhelmed by a conviction of sin and the need of a Saviour can be born again. The prodigal son went away deliberately, but a spasm of repentance brought him back to his father's house.

One does not have to understand God to believe that there is a God. It is not necessary to understand the sun or the lightning in order to believe that there is a sun, and that there is such a thing as lightning. We must deal with the facts of nature. The fact that a man cannot understand the mysteries of nature is no proof that those things are not true. The miracles of the Bible are no more difficult to understand than the mysteries of nature—the fact that there is a God explains both.

THE EVOLUTIONIST

The Higher Critic is a close ally of another enemy of the Bible, which is the worst one of all. The greatest enemy of the Bible is the *numerous* enemy, and the numerous enemy today is the believer in the Darwinian hypothesis that man is a lineal descendant of the lower animals. Atheists, Agnostics and Higher Critics begin with Evolution: they build on that.

I must spend a little time on the Darwinian hypothesis. I believe this is the greatest menace to the church today: the doctrine that man was not created by God by a separate act and placed here for a special task assigned to him, but is blood kin to the brutes below him.

If the Bible deals with one thing only, "the Science of How to Live," and declares that man is God's supreme handiwork, would it not seem likely that the Bible would say something to support this hypothesis, if it is true? You cannot find a single sentence in the Bible—not a word or a phrase or a syllable—that in the most remote way suggests support of the Darwinian hypothesis.

First Corinthians 15:39 would seem to directly contradict Darwin's hypothesis: "All flesh is not the same flesh: but there is

one kind of flesh of men, another flesh of beasts, another of fishes, and another of birds."

That may not embarrass the believer in Darwinism. He says he proves Evolution by nature, and so I meet him on his own ground, and assert that there is not one fact in nature that supports the Darwinian hypothesis. All the facts of nature are against it.

Let me give you some of the facts that are against it (and may I suggest to you that you read the book called "The Other Side of Evolution," by Alexander Patterson. You can obtain it from the Bible Institute Colportage Association). You will find that those who accept Darwinism do not usually present an argument. They simply express surprise: "What! don't you believe in it? I am surprised!"

You say, "What do you know about it?"

They answer, "I don't know very much about it, but everybody believes in it."

That argument comes from a mother whose daughter had just returned from Wellesley. !!! YEA!

Let me give you some facts; then you can question some of these people who tell you that Darwinism is an accepted fact. In the book referred to you will find a statement to the effect that we have now found

nearly one hundred species of vertebrate life in the early rocks, and more than half of them live today. In not a single case is there any material change from the time they were buried in the rocks until today. Now, if this is true, is it not an argument against the hypothesis that everything we see is the result of change?

Another fact: They have yet to find a single species that has changed from another species. If it is true that all these things have come through change, would you not think it possible to find at least one illustration on which to base the argument? But they cannot do it. There is not an illustration in all God's universe, so far, of one single species coming from another, and yet the whole hypothesis rests upon the assertion that in the beginning there were just a few invisible germs of life and that everything came from them. If that were true, we should find evidences of transition everywhere, but there is not a single example to be found—not a single one in process of transition—all perfect.

All nature confirms God's law, as recorded by Moses, that every living thing shall bring forth after its kind; Darwin's hypothesis of variation is confirmed nowhere.

Is it not strange that an hypothesis can last

for fifty years without a fact to support it? If the followers of Darwin would call it "guess" instead of "hypothesis" it would not last a year. H. G. Wells has been writing some articles lately suggesting a *new bible.* This is quite a natural suggestion if one follows Darwinism to its logical conclusion. One evolutionist suggests that instead of teaching the Bible in the common schools, we should teach science in the Sunday-schools.

Wells' latest book begins with pictures of so-called missing links. If you see these in museums, you may be misled. But do they look like the "links" as they were when they were found? They find a piece of a skull, two teeth, and a bone of a leg: they don't know whether the teeth came out of the skull or whether the leg bone belongs to the teeth, but some man fixes the parts up according to his imagination and calls it a missing link. A man who can do this could take a keyhole and build a house around it. If anyone tells you that they have found the missing link, tell him that there is a group of scientists in Africa now. They went from New York just a few months ago; they are to stay five years, using money supplied by some rich men. They are hunting for the missing link—and the longer they stay

the better. It is far better to have them there than to have them poisoning the minds of students in this country. If they would spend half as much time trying to link themselves to God as they do trying to drag mankind down to a monkey ancestry, they would be making better use of their time. If we have found the missing link why hunt for it? If not, why not wait for it before believing in it?

But all the links are missing. I do not object to an absurd hypothesis when it does not hurt anyone. But these imaginings are not only groundless and absurd but harmful. You do not know what trouble you have taken on when you try to explain everything according to Evolution! You will not live long enough, even if you do nothing else. There is too much important work to be done to justify our wasting a whole lifetime in trying to explain changes that have not occurred.

If you ask me how man was made, I answer, Moses tells us. Can God really do that? The God who can make a whole world can do anything He wants to. How did the eye come? When God made man, He made the eyes and carved out caverns in the skull in which to hang them. It is easy for us to believe in a God who can do all things.

But if you try to find out how the eye came and *leave God out,* you have to guess. There was a time (according to Evolutionists) when animals had no eyes, and as they now have them there must have been a time when they came. Since God is not allowed to make an eye, it just happened! When you have nothing else to do just look it up—not taking valuable time, but just the time you have to throw away. But perhaps I had better tell you.

These people will not let God work; they shut Him out of His own universe; and they try to explain how things happened. This is one guess. (If you find any others, let me know, because any other will be better than this.) The guess is that there was a time when the little animal did not have any eyes and, as it was time for it to get an eye, there just happened—no design about it, it just happened—that a little piece of pigment (some call it a freckle) came on the skin. That converged the rays of the sun, and when the little animal felt the heat on that spot it turned it toward the sun to get more heat. The sun's heat irritated it, and a nerve came there, and out of the nerve came the eye! Can you beat it?

This only accounts for one eye, and there had to be another freckle pretty soon, and

that had to come in just the right place. Suppose it had come on the back of its neck. Not only might it have made us less handsome, but, what is worse, suppose the little animal had stopped trying to perfect the one eye before it started on the other. It might have lost the one without getting the other!

And then there was a time when the little animal had no legs, and the leg had to come. Since they will not let God work, what is the guess? Well, as this little animal was wiggling along a wart came on its belly—just happened. It found that it could use this wart to work itself along, and finally it developed into a leg. Only one leg, of course, and the other had to come in just the right place. Isn't it strange that they can teach this tommy-rot to students and look serious about it!

Lest the hearer may think the above explanations of the eye and leg too absurd to be seriously advanced by evolutionists, I quote the following confirmation from a book recently published by a very prominent Eastern clergyman.

"The force of this fact is more clearly seen when one considers that man has grown up in this universe, gradually developing his powers and functions as responses to his environment. *If he has eyes, so biologists as-*

sure us, it is because light waves played upon the skin and eyes came out in answer; if he has ears, it is because air waves were there first and ears came out to hear. Man never yet, according to *the evolutionist,* has developed any power save as a reality called it into being. *There would be no fins if there were no water, no wings if there were no air, no legs if there were no land.* Always the developing organism has been trying to 'catch up with its environment.'"

How long did the "light waves" play upon the skin before the eyes "came out in answer"? How did each new generation retain the irritation caused by the "light waves" playing on the skin of preceding generations for millions of years—or was it all done in *one* generation? Why do not the "light waves" continue to "play" and call out eyes all over the body? And why do we not see eyes and ears and legs and fins and wings still in process of development? Evolution seems to open the mind to the most impossible guesses advanced in the name of science, while it closes the heart to the plainest spiritual truths.

But there is something more interesting to me than that. Of course I am interested in all this, but Darwin takes up a matter that touches me deeply. He tells us how we

men came to have brains superior to the women. Do you know how we came to have these superior brains? Darwin tells about it.

He says that when our ancestors were brutes, the males fought for the females, and they fought so hard that this struggle increased the brain power in the males, and this increased brain power descended to the males—just to the males. Even if we cannot prove that we have these superior brains, it is nice to know how we came to have them.

But don't think that Darwin devoted all his time to us men. He showed how the females did their part. (That was before they were women.) The getting of this superior brain power is not so important as getting rid of the hair. There was a time when all the animals had hair, and the question that bothered Darwin most was how a hairy animal was transformed into a hairless man. He could not explain it by natural selection, because the less hair a man had the less able he was to protect himself against the weather. He attributed it to the selection of the males by the females. He said the hair was bred off by the females preferring the males with the least hair. Of course it required ages, but that is one advantage the Evolutionist has. If you say

that a certain thing could not be done in a thousand years, he says, "Take a million years—a billion: take all the time you want." He hurls eons at you and dissolves opposition in the mist of ages.

But why did he not think that maybe all the females would not agree in such a preference? If no two women can agree as to a hat, how could the female brutes *all* agree in so impractical a thing as breeding the hair off? And if that was so universal a taste back there as to account for the breeding off of the hair, would you not suppose that that taste would "persist," as Evolutionists say, and that we would notice it in women today —so that bald-headed men would have a greater advantage than they have?

And has it not occurred to you that it might be difficult, if not impossible, for us men to get these brains we have by the males selecting the females, if at the same time the females were breeding the hair off selecting the males? Could they both select at once, or did they alternate and make brains for three years and then decrease hair during leap year?

I am telling you what Darwin says. He says that this argument about breeding off the hair was criticized more severely than anything else he said, which proves that

there were people in those days, as well as today, with common sense. Yet this is what we find in a doctrine that "everybody believes."

I want to show you the extremes to which Evolution will lead those who believe in it. I cut this out of a newspaper. I was passing through Philadelphia last November next day after a professor from a college in Pennsylvania spoke there. He was an extension professor and had extended to Philadelphia. He was enlightening an audience, and this is what the paper says he said. He covered two very important questions, one of which is of special interest to mothers. "A baby can wiggle its big toe," he said, "without wiggling its other toes; this is an indication that it once used its big toe in climbing trees." This must have been a puzzling question to mothers throughout the years. But their ancestors once did this (we are told) and the children can't get out of the habit.

Here is the other serious question. "We often dream of falling," he says. "Those who fell out of the trees some fifty thousand years ago and were killed, of course, had no descendants." (Now this is a fact which I will admit. It is highly probable that this was true.) "So those who fell and were not

hurt, of course, lived." (Which would be a natural presumption.) "So we are never hurt in our dreams of falling," because we are descended from those who fell and were not hurt. If I were a betting man, I would bet sixteen to one that that professor does not believe that Daniel or Joseph could interpret dreams, but he thinks *he* can. Are there not more important things for our professors to do than to spend their time in such speculation?

I recently read an article in the *Sunday School Times* about a professor in one of our Illinois institutions. He tells of the *great* day in the world's history. It looks as if we have made a mistake in the days we celebrate, such as Christmas, Fourth of July, Washington's Birthday, and the rest. The really great day, the professor says, was a day, not yet definitely fixed, when a water puppy crawled up onto the land and decided to live there, and became man's first progenitor!

An "eminent scientist," so a dispatch from Paris says, reports that he recently talked to the soul of a dog and learned that the dog was happy. Must we believe this, too?

This doctrine of Evolution leads you into the wildest of speculations. "The Arabian Nights" have nothing to compare with the

guesses of scientists. Science can do anything when it builds on facts. It gives us rules for the use of electricity and steam and gas. It tells us about the fertility of the soil and the rotation of crops, but it is dealing with facts. When a scientist goes to guessing he is no better than any other guesser. If we must have fiction it would be better to hire a crippled girl who cannot work to read "Grimm's Fairy Tales" to students than to have them taught the fiction of Evolution.

I have given you some illustrations of this fiction; what is the natural effect? It leads people away from God. They will say that it does not lessen their reverence for God to believe that millions of years ago He gave to a germ power to develop. It is true that He *could* do this, but that is not the question. Will you feel the same towards Darwin's far-away God as you feel toward the God of Moses? Darwin does not give God a chance after the first germ of life came upon the planet two hundred million years ago (according to his estimate). Some have put it farther away and some less. Exactness would seem immaterial when one scientist says twenty-four million and another three hundred and six million years. Suppose that for twenty-four millions of years God has never touched life on this planet; that means

that He has never inspired a man or laid His hand upon the destiny of a nation or a race. It recalls Elijah and the prophets of Baal. He told them to pray again, suggesting that their god was asleep. Darwin tells us that our God has been asleep for two hundred millions of years, and those who believe in his doctrine do not emphasize the fact that our God has ever been awake.

Some go back to the nebular hypothesis. This very year Canon Barnes, of Westminster Abbey, has given his interpretation of Evolution. He says the universe was filled with "stuff" out of which came electrons; out of them, matter; out of matter, life; out of life, mind; and out of mind, soul. There was a time, he declared, when there was no matter, no life, no mind, no soul. Now they are here, "a part of God's plan." But God has not been allowed to do anything for billions of years. How long do you think it has been if the nebular hypothesis is correct?

It requires measureless credulity to enable one to believe that all that we see about us came by chance—by a series of happy-go-lucky accidents. If only an infinite God could have formed hydrogen and oxygen and then united them in just the right proportions to produce water—the daily need of every living thing, scattered among the flowers all

the colors of the rainbow and every variety of perfume, adjusted the mocking bird's throat to its musical scale, and fashioned a soul for man, why should we want to imprison such a God in an impenetrable past? This is a living world; why not a living God upon the throne?

When I was a boy in college the materialists began with matter separated into particles infinitely small and each particle separated from every other particle by distance infinitely great. But now they say that it takes 1,740 electrons to make an atom of infinite fineness. God, they insist, has not had anything to do with this universe since 1,740 electrons formed a chorus and sang, "We'll be an atom by and by!"

I had a letter from one preacher who told me I was lessening my influence with the thoughtful. Another said I could not enter the freshman class of any theological seminary. I am not trying to enter the freshman class; I am lecturing to students. Some criticize me for dissenting from Canon Barnes, but I am trying to bring people back to believe that man was made in the image of God.

What is the result of Darwin's doctrine? What would you suppose would be the result? Here is a boy reared in a Christian

home, learning the first child's prayer and then the Lord's Prayer; he talks to God, asks for daily bread, pleads for forgiveness of sins, and desires to be delivered from evil. He reads the Bible and finds that his life is precious in the sight of God, and that the heavenly Father is more willing to give good gifts to His children than earthly parents are. Then he goes off to college and a professor takes a book six hundred pages thick and tries to convince him that his body is a brute's body. "See that point in the ear? That comes from the ape," etc. Darwin also tries to convince the child that there is nothing in his brain that is not found in miniature in the brain of the brute.

Then he says that the morals of man are a development from the brute. First, second, third, fourth, fifth, sixth—and no mention of God or of religion. No mention of conscience. When the boy goes out from school, if he believes Darwin and believes his teacher, the Bible is to him a story book. Christ is reduced to the stature of a man with an ape for his ancestor, on his mother's side at least, and, as many teachers believe, on his father's side also. I have pointed out the natural, logical consequences of Darwinism —observation convinces me that they are the *actual* consequences.

Are you surprised when I tell you that within a month I met a young man twenty-two years of age who said he had been made an atheist by two teachers in a Christian college? A mother in northern Minnesota told me that her boy had become skeptical in college and had been brought back by a religious speech. He is now the leading Presbyterian preacher in his town. This year I received an invitation to speak at a high-school commencement in this state from a boy in the senior class who told me that he had been made skeptical on religion during his sophomore year, and that several of the others were agnostic.

In Miami, Florida, a mother told me that her boy would not pray; she found that he believed in the Darwinian doctrine. A father tells me of a daughter educated at Wellesley who calmly informs him that no one believes in the Bible now; a teacher in Columbia University begins his lessons in geology by asking students to lay aside all that they have learned in Sunday-school; a professor of the University of Wisconsin tells his class that the Bible is a collection of myths.

Last fall the president of one of the largest of the state universities (and a Doctor of Divinity, too), in an address on *religion,*

said to 3,100 students: "I go so far as to say that, if you can not reconcile religion with things taught in biology, in psychology, or in other fields of study in this university, then you should throw your religion away."

A professor of philosophy at Ann Arbor occupies a Sunday evening explaining to an audience that Christianity is a state of mind and that there are only two books in the Bible with any literary merit; another professor in the same institution informs students that he once taught a Sunday-school class and was active in the Y. M. C. A., but that no thinking man can believe in God or the Bible; a woman teacher in the public school in Indiana rebukes a boy for answering that Adam was the first man, explaining to him and the class that the "tree man" was the first man; a professor in Yale has the reputation of making atheists of all who come under his influence—this information was given by a boy whose brother has come under the influence of this teacher; a professor in Bryn Mawr combats Christianity for a session and then puts to his class the question whether or not there is a God, and is happy to find that a majority of the class vote that there is no God; one professor declares that life is merely a by-product and will ultimately be produced in the labora-

tory; another says that the ingredients necessary to create life have already been brought together and that life will be developed from these ingredients, adding however that it will require a million years to do it. They are robbing our boys and girls of spiritual life. A professor cannot cram enough intelligence into a boy's brain to offset the shrinkage of the heart when he takes God out. I have reached two conclusions: First, that all teachers in Christian colleges should be Christians with a spiritual view of life; and second, that where in public institutions we are not allowed to defend the Bible, they should not be allowed to attack it and rob our children of their faith and hope.

Nietzsche took this hypothesis, brought man down to a brute basis, taught that might makes right, and laid the foundation for the greatest war that man ever knew. He got it from Darwin. He says Darwin was one of the three great men of his century. He praises Napoleon as the greatest because he made war "respectable" again. I have here a quotation from an editor in Paris, written when there was a peace meeting there, some twenty-one years ago: "The spirit of peace has fled the earth because Evolution has taken possession of it. The plea for peace in past years has been based upon the divine

nature and divine origin of man. Men were looked upon as the children of one God and war was, therefore, fratricide. But now that men are considered children of apes, what matters it if they slaughter one another?" This was fifteen years before the war began.

A prominent English writer, in a book published by Putnam's Sons this year, says: "Darwinism not only justifies the Sensualist at the trough and Fashion at her glass; it justifies Prussianism at the cannon, and Bolshevism at the prison door. If Darwinism be true, if Mind is to be driven out of the universe and accident accepted as a sufficient cause for all the majesty and glory of physical nature, then there is no crime in violence, however abominable in its circumstances and however cruel in its execution which can not be justified by success, and no triviality, no absurdity of fashion which deserves a censure; more—there is no act of disinterested love and tenderness, no deed of self sacrifice and mercy, no aspiration after beauty and excellence, for which a single reason can be adduced in logic. On these grounds alone Darwinism is condemned; but it is condemned also on scientific grounds."

The reason this pernicious doctrine has not done more harm is that it has not reached

the mass of the people. Their "everybody" does not include all of society. Less than one in ten of our boys and girls ever go to a high-school, and only one in fifty—less than two per cent—attend college or university. Only about one boy and girl in one hundred, on the average, graduates from a college or university, but it is those who have the most education who have been injured most by this doctrine. It has not yet misled the masses; the people, as a rule, do not believe in the ape theory.

Darwin gives us a family tree which begins in the water with "larvae" and then traces the line of descent to European apes—he does not even allow us the patriotic pleasure of descending from *American* apes. Over eight hundred times he uses the phrase, "We may well suppose." Compare this phrase with the Bible's "Thus saith the Lord"! The Bible is built upon the rock and the other upon hypothesis. When they tell you that their sciences are the most important, you can answer that there is a science more important than any they teach in the schools. It is the Science of How to Live. It is more important that you trust the Rock of Ages than that you know the age of the rocks. When those who teach the physical sciences look down upon those who preach the Gos-

pel, tell them what Paul said, that the things which are seen are temporal; the things that are unseen, eternal.

I will now show you the actual effect of Darwinism. There is a book by James H. Leuba, published five years ago (in 1916), by Sherman, French & Co., Boston (now sold by the Open Court Pub. Co., Chicago). This man is a professor in Bryn Mawr College, in Pennsylvania. The book was written to prove that belief in God and immortality is passing away. Professor Leuba takes a list of scientists, biologists, sociologists and psychologists—the most prominent in the country—and asks them to answer certain questions. He then gives the figures to show that *more than half* of these prominent men do not believe in a *personal God* and *personal immortality*. He then takes nine representative colleges and questions the students, boys and girls, and states as the result of his investigation that the largest percentage of believers (85 per cent) are in the freshman class; the percentage decreases until they come to the senior class. He declares that at graduation, from forty to forty-five per cent of the boys do not believe in a personal God or in personal immortality. The percentage of believers is greater among the girls than among the boys. He explains this

by saying that the men are stronger and more independent: that the women are clinging, and rely more upon faith. Thank God for a faith that keeps one true!

This man argues that the more intelligent men are the less they believe in God and immortality. Are you willing to admit that intelligence is antagonistic to Christianity, that as men become more intelligent they will have less belief in God, the Bible, and in Christ? I will not admit it. The Christian church will not admit it: it is not true. There is an explanation; what is the reason?

I believe it is because of the acceptance of this false philosophy that takes away from man his belief in God and leads him to worship his own mind instead. What we need is to have our boys and girls come from our colleges and universities with a spiritual vision back of their trained minds, so that they will take up the work of the Sunday-school, the church and society. A canvass of the graduates of one state university showed that only twenty-five per cent of the boys and girls who went from Christian churches and Sunday-schools ever returned to take up their religious work again. Brains must be trained and then consecrated to the service of the Most High. We cannot afford to have the lives of our people robbed

of all spirituality and brought down to a brute basis.

Theodore Roosevelt, when President, talking to the Harvard law students, told them that there was scarcely a great conspiracy against the public welfare that did not have Harvard brains behind it. This might have been said at any other university as well. Many graduates go out with no sense of responsibility to God or society: they are the bulwark of every unrighteous cause, the defenders of every vicious system. This is not true of *all* college graduates; many do not accept Darwinism, and many evolutionists do not follow the doctrine to its logical conclusion. When reform starts in this country, it starts with the masses. Reforms do not come out of the brains of scholars. Some of these young men after graduating from our colleges go into business and become profiteers. They do not commit petit larceny; people are punished for that. Sometimes they commit grand larceny; sometimes they go into glorified larceny, and use lawyers who come out of our colleges to keep them out of the penitentiary. We have to enact child labor laws to keep college graduates from dwarfing the bodies and souls of little children. Anti-trust laws are necessary to keep them from ruining small competitors.

I believe the brute in man is brought out largely by the theory that makes man believe he is blood relative to the brute. Man must be brought back to God, to a belief in the Bible as the Word of God, and to a love of Christ as the Son of God. No mental processes can stop the mad race for money. Man must be born again. "What shall it profit a man, if he shall gain the whole world, and lose his own soul?" must become a living force in his life.

I come to present to you the Bible as the Word of God, and to protest against the enemies, open and secret, who would lift man from his knees, take from him his faith in God and withdraw from his life the restraining influence of a belief in immortality. I believe that the Darwinian doctrine leads people into agnosticism and pantheism, plunged the world into the worst of wars, and is dividing society into classes that fight each other on a brute basis. It is time that the Christian church should understand what is going on and array itself against these enemies of the church, Christianity, and civilization.

(Addendum)

THE EFFECT OF THE EVOLUTION THEORY ON DARWIN HIMSELF

I HAVE spoken of what would seem to be the natural and logical effect of the Darwin hypothesis on the minds of the young. This view is confirmed by its actual effect on Darwin himself. In his "Life and Letters" he says: "I am much engaged, an old man, and out of health, and I cannot spare time to answer your questions fully—nor indeed can they be answered. Science has nothing to do with Christ, except in so far as the habit of scientific research makes a man cautious in admitting evidence. For myself, I do not believe that there ever has been any revelation. As for a future life, every man must judge for himself between conflicting vague probabilities."

It will be seen that science, according to Darwin, has nothing to do with Christ, except to discredit revelation which makes Christ's mission known to men. Darwin himself does not believe that there has ever been *any revelation,* which, of course, excludes Christ. It will be seen, also, that he has no definite views on the *future life*—"every man," he says, "must judge for himself between *conflicting vague probabilities.*"

It is fair to conclude that it was *his own doctrine* that led him astray, for in the same connection (in "Life and Letters") he says that when aboard the *Beagle* he was called "orthodox," and was heartily laughed at by

several of the officers for quoting the Bible as an unanswerable authority on some point of morality." In the same connection he thus describes his change and his final attitude: "When thus reflecting I feel compelled to look for a First Cause, having an intelligent mind in some degree analogous to that of man; and I deserve to be called a Theist. This conclusion was strong in my mind about the time, as far as I can remember, when I wrote the 'Origin of Species'; and it is since that time that it has very gradually, with many fluctuations, become weaker. But then arises the doubt: Can the mind of man, which has, as I fully believe, been developed from a mind as low as that possessed by the lowest animals, be trusted when it draws such grand conclusions?

"I cannot pretend to throw the least light on such abstruse problems. The mystery of the beginning of all things is insoluble by us; and I for one must be content to remain an Agnostic."

A careful reading of the above discloses the gradual transition wrought in Darwin himself by the unsupported hypothesis which he launched upon the world, or which he endorsed with such earnestness and industry as to impress his name upon it. He was regarded as "orthodox" when he was young; he was even laughed at for quoting the Bible "as an unanswerable authority on some point of morality." In the beginning he regarded himself as a Theist, and felt compelled "to look to a First Cause, having an intelligent mind in some de-

gree analogous to that of man." This conclusion, he says, was strong in his mind when he wrote "The Origin of Species," but he observes that since that time this conclusion has very gradually become weaker, and then he unconsciously brings a telling indictment against his own hypothesis. He says, *"Can the mind of man* (which, according to his belief, has been possessed by the lowest animals) be *trusted* in such mysteries?" He first links man with the animals, and then, because of this supposed connection, estimates man's mind by brute standards.

Who will say, after reading these words, that it is immaterial what man thinks about his origin? Who will deny that the acceptance of the Darwinian hypothesis shuts out the higher reasonings and the larger conceptions of man?

On the very brink of the grave, after he had extracted from his hypothesis all the good there was in it and all the benefit it could confer, he is helplessly in the dark, and "cannot pretend to throw the least light on such abstruse problems." When he believed in God, in the Bible, in Christ, and in a future life, there were no mysteries that disturbed him; but a *guess,* with nothing in the universe to support it, swept him away from his moorings and left him in his old age in the midst of mysteries that he thought insoluble. He must content himself with Agnosticism. What can Darwinism ever do to compensate any one for the destruction of faith in God, in His Word, in His Son, and of his hope of immortality?

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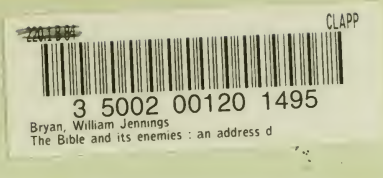
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CONTENTS.

INTRODUCTION 5

I. THE ORIGIN OF MAN 9

II. PHYSIOLOGICAL ANALOGIES 16

III. ON THE DEVELOPMENT OF SPECIES 24

IV. THE MENTAL POWERS OF MAN AND ANIMALS 28

V. ON INSTINCT AND REASON 34

VI. ON THE MENTAL POWERS (*continued*) 40

VII. ON LANGUAGE 50

VIII. THE MORAL SENSE, OR CONSCIENCE 55

IX. ON RELIGION 60

X. SUMMARY AND CONCLUSION 64

INTRODUCTION.

THE author of *The Descent of Man* and *The Origin of Species* is Charles Robert Darwin, M.A., F.R.S., a living naturalist of the highest eminence. Through the publication of these works, his name has become familiar as a household word to the mass of educated men, not only in England but throughout the world. He is the son of Dr. Robert Darwin, and grandson of Dr. Erasmus Darwin, the poet, philanthropist, and scientific physician of Lichfield. And it may be that Charles Darwin, the author of *The Descent of Man*, may have inherited from his grandfather Erasmus, who wrote such amusing and suggestive poems as *The Loves of the Plants*, that general tendency towards a particular line of speculation. The witty satirists of the day made much fun out of the elder Darwin's fanciful descriptive poetry, and did not fail to throw ridicule upon his theories of the transformations of vegetable and animal life. They parodied his *Loves of the Plants* with the *Loves of the Triangles*. This Dr. Erasmus Darwin had his own notions of development, and in some points his speculations went far beyond those of his grandson, for in 1794 he wrote thus:

"I think it not impossible that the first insects were the anthers or the stigmas of flowers, which had by some means loosed themselves from their parent plant, and that many other insects have in long process of time been formed from these, some acquiring wings, others claws, and others fins, from their ceaseless efforts to procure their food, or to secure themselves from injury." Thus we have the germ of what is now known by the name of Darwinism, though the present Mr. Darwin has not yet conducted us so far back as to find the origin of birds, beasts, and fishes in the anthers of flowers which had become detached from their parent plant.

Mr. Charles Darwin, the philosophical naturalist whose name is now so intimately linked with the evolution theory, was born at Shrewsbury in 1809, being the son of Dr. Robert Darwin, physician of that town. His mother was a daughter of Josiah Wedgwood, the modern founder of the English pottery manufacture. After attending a public school at Shrewsbury, he studied at Edinburgh University, and thence proceeded to Cambridge, where he took his degree of B.A. in 1831. His aptitude for the study of natural science must have been early perceived by his instructors, as he was recommended to Captain Fitzroy and the Lords of the Admiralty when a naturalist was chosen to accompany the surveying expedition in H.M.S. the *Beagle* in the southern seas. The *Beagle* made a scientific circumnavigation of the globe, and Mr.

Darwin's journal of this expedition is a most attractive book. Since that voyage he has not personally engaged in any distant explorations, yet his entire life, as far as health would permit, has been devoted to scientific researches. During many years past he has resided near Farnborough in Kent. He married his cousin, Miss Emma Wedgwood, by whom he has a large family. The honours of several British and foreign scientific societies have been freely conferred upon him. Mr. Darwin's reputation is independent of the "evolution" theory by which his name has been so much associated since his publication of *The Origin of Species*, and still more by his *Descent of Man*.

The theory of "development" is not new. More than twenty centuries ago it was discussed in the schools of Greece, of Egypt, and of India. Democritus, the illustrious Greek philosopher, believed that life, consciousness, and thought, were derived from the finest atoms of matter. He did not acknowledge the presence of *design* in nature, but he admitted that of *law*, which was supreme. The theory of "evolution," or development, would in all ages be attractive to minds of a certain disposition, eager to imagine one sole cause of the boundless diversity of phenomena in nature. Though such inquiries should be freely made, they ought not to pass into the region of scientific truths unless based on positive induction from observed facts. Plato once gave to the world a beau-

tiful theory of celestial motion, in harmony with his ideas of propriety and the dignity of nature. It had, we believe, but one little fault—it was not true. Our inquiry and examination of Mr. Darwin's theory of development will be to ascertain whether it is *true* or not. We shall waive all considerations of whether those views bring honour or dishonour to the dignity of man's nature; and with one set purpose in view, we shall inquire into the evidence brought to substantiate the doctrine of Darwinism. However plausible a speculative theory may be, in seeming to afford an explanation of many facts we observe, that is not a conclusive argument of its truth, even when no other explanation is forthcoming. Scientific truth must stand on its own basis of logical induction from well-ascertained facts.

CHAPTER I.

THE ORIGIN OF MAN.

MR. DARWIN'S theory is, that man, "the wonder and glory of the universe," has descended from animals of a lower organisation; that by a gradual and continuous "evolution" or development, some lowly organised animal has gone on improving in body and mind until at last it attained the noble form and proportions of man. Such a great and wonderful process must have taken almost endless ages to accomplish. And as Mr. Darwin does not limit us to millions or even billions of years, we may leave, for the present, the question of time out of our calculations.

Beginning at the very lowest type of animal life, a kind of jelly-fish, with its young floating about in the form of tadpoles, Mr. Darwin has set himself the task of showing how these animals have become beautified, strengthened, and improved, until they became men. The means used in this great transformation were, mainly, according to Mr. Darwin, natural and sexual selection, "aided perhaps by other influences and laws as yet undiscovered." Having attained manhood, these intelligent animals then diverged into distinct races,

or species, as widely different as the European and the Negro races.

After giving man a very long pedigree, Mr. Darwin comes to the "belief" in his own mind that "man is certainly descended from some ape-like creature," and so vividly does he realise to himself this interesting ancestor of ours, that he "can partly recall in imagination the former condition of our early progenitors, and can approximately place them in their proper position in the zoological series. We thus learn that man is descended from a hairy quadruped, furnished with a tail and pointed ears, probably arboreal in its habits, and an inhabitant of the Old World." As Mr. Darwin has favoured us with many illustrations of birds and beetles, frogs, monkeys, and butterflies, would it not have been highly interesting to have seen an actual sketch of this great ancestor of ours, the "hairy quadruped," with "a tail and pointed ears." This is not, we think, asking too much of Mr. Darwin, for he has so traced out in detail the "animal" from which we have all sprung, that he tells us exactly what place he would have occupied in our present system of zoological classification, and by another effort of imagination, "in the dim obscurity of the past," Mr. Darwin can see that the early progenitor of the Vertebrata must have been an aquatic animal," provided with gills, and having the heart and brain imperfectly developed. And this animal, he remarks, "*seems* to have been more

like the larvæ of our existing marine Ascidians than any other known form." A deep interest will naturally be excited in us to know something more of our early forefathers—who they were and what they were. We are furnished with a lucid explanation, "An Ascidian is an invertebrate, hermaphrodite, marine creature, permanently attached to a support. They appear scarcely like animals, and consist of a simple, tough, leathery sack, with two small projecting orifices," and their larvæ somewhat resemble tadpoles in shape. Here we behold the origin of man, and here we see our blood relations in those tadpole-like creatures. Through a long line of diversified forms we have arrived at the very earliest ancestors of man, and here let us pause a moment and take breath ere we start on the return journey to trace the Ascidian up to man. This, as a reviewer wittily remarks, we may call "the ascent of man." The two ends of this vast and almost measureless chain of animated beings are man and a fish-like animal. From this lowly organised creature, floating about like a tadpole, there gradually grew and developed higher and higher forms till the last link of the series—Man erect and godlike—was the result.

Such are the grand teachings of science aided by the "imagination." There is no break in this vast chain of organised beings from the "marine creature," the jelly-fish, up to man—or where the links are wanting, Mr. Darwin's "imagination" can readily furnish them. Professor Tyndall, who

last year expatiated so grandly on the "Uses of the Imagination in Science," ought to feel complimented that his views have been so freely adopted by Mr. Darwin, whose imagination is so fertile that he does not hesitate to let it take the place of science, when the means and methods of science fail. So strong, indeed, is the imaginative faculty in Mr. Darwin, that in "the dim obscurity of the past," where darkness and chaos reign, he can descend and call from the vasty deep, not spirits, but tadpoles; and distance so far lends enchantment to the view, that he beholds in them the "earliest progenitors of man." Plato, like Mr. Darwin, was a great philosopher, but when he left the region of facts for that of fancy, he enunciated some strange theories. He imagined that men and women were originally united, and went about with four legs and four arms, but that the gods, as a punishment for their sins, split them in half, and threatened them that, if they did not take care, they would be split up again and sent hopping about the world on one leg. So we see that Mr. Darwin has good authority, both amongst ancients and moderns, for the free use of the "imagination." But Mr. Darwin is in earnest on this matter, and can see no break in the evolutionary series, for he strongly insists that there is no difference in *kind*, but only in *degree*, between the lowest animal and the highest intellect of man: so that in these Ascidians there are the undeveloped germs of a mind like that of a Newton or

a Shakespeare, which only require *time* and *selection* to produce the one from the other. Such we understand the doctrine of Darwinism to be.

As we have no information as to where or how the Ascidians originated,—whether they were formed by a special act of creation, or were developed out of some vegetable form,—we must leave them and take the first step upwards in Mr. Darwin's evolutionary series. These Ascidians "probably gave rise to a group of fishes as lowly organised as the lancelet." The lancelet inhabiting our coasts is only about two inches in length, and is interesting for its curious organisation. Its negative qualities are the most remarkable, there being no vestige of a skull nor any enlargement of the spinal cord into a brain, and in lieu of a heart it only possesses a few elongated blood-vessels. The older naturalists classed it among worms, but it has now been raised to the dignity of a fish, on account of its muscular system being similar to that of fishes. We are now one grade nearer to man when we look upon this poor brainless lancelet, and undoubtedly much "development" must yet take place before we reach the paragon of animals. Mr. Darwin now informs us, that from the lancelet, "the Ganoids, and other fishes like the lepidosiren, must have been developed." This is a considerable step from the lancelet to the Ganoids, with their shining scales of bright enamel. Many of the genera are extinct. "The lepidosiren and some few ganoid fishes, such as the sturgeon,

have been preserved from utter extinction by inhabiting our rivers," which to them are harbours of refuge. The lepidosiren is a most remarkable animal, and forms a connecting link between the Amphibians and fishes. The specimens of lepidosiren brought to England from Africa are about a foot in length. Their bones are soft and gelatinous, and present many peculiarities. From such a fish "a very small advance would carry us on to the Amphibians," which includes in its highest division frogs and toads.

Here Mr. Darwin points out the close alliance between the Ganoids and the Amphibians, and it is now that he first favours us with photographs of our ancient forefathers—namely, frogs, toads, and long-tailed Tritons. And yet, withal, we feel some difficulty in realising our kinship with them. Our next step is a somewhat difficult one, for, unfortunately, "no one can at present say by what line of descent mammals, birds, and reptiles were derived from the Amphibians and fishes." Having bridged over by imagination the slight gap between the Amphibia and Mammalia, we find it is not difficult to conceive the steps which led from the ancient Monotremata to the ancient Marsupials. The Monotremata form the lowest division of the great Mammalian series, and at the present are represented solely by the ornithorhynchus, or duck-billed platypus and echidna. These two forms are considered the relics of a larger group which have been preserved in Australia through favourable

circumstances. These Monotremes are eminently interesting, as in some points of structure they lead towards the class of Reptiles, and yet belong to Mammals. By easy steps we ascend to the Lemuridæ, "and the interval is not wide from these to the Simiadæ." Then we are told "the Simiadæ branched off into two great stems, the new world and the old world monkeys; and from the latter, at a remote period, man, the wonder and glory of the universe, proceeded. Thus," remarks Mr. Darwin, "we have given to man a pedigree of prodigious length, but not, it may be said, of noble quality." The pedigree is, indeed, prodigious, and as for the nobility, it would seem to be reflected backwards, on the Chinese system, according to which persons, who distinguish themselves, ennoble not their children, but their ancestors.

What a pride of heart, if they have any, these lowly organised Ascidians must feel as the honoured progenitors of man. And could they but articulate their reflections, we might hear them moralising in Shakesperian language, "What a piece of work is man!—how noble in reason! how infinite in faculty!—in form and moving how express and admirable! in action, how like an angel! in apprehension, how like a God!"

But stern science, with its hard facts and its logical deductions, recalls us from the region of fancy, and demands to know if there is any proof of this "prodigious pedigree?"—if any ascertained law or principle by which it can be explained?

CHAPTER II.

PHYSIOLOGICAL ANALOGIES.

WITHOUT reference to the origin of the higher faculties of the human soul, which this genealogy involves, the physical theory of development first demands a careful scientific examination. Let us now see what proofs Mr. Darwin can produce in favour of his great and momentous theory. In the first place, we are told, respecting the bodily structure of man, that it is notorious that he "is constructed on the same general type or model with other Mammals;" and that all the bones in his skeleton can be compared with corresponding bones in a monkey, bat, or seal." And, still further, he adds that the muscles, nerves, blood-vessels, and even "the brain of man has its analogy in that of the orang." Precisely so. All this is well known to every physiologist; but, as Mr. Darwin admits, there is no period of life when those organs perfectly agree. Therefore, this argument of general analogy of physiological structure is of little value. Mere general resemblances prove nothing at all, and are hardly the "proofs" we should expect from a philosophical naturalist. Still further, Mr. Darwin urges that,

as man is liable to communicate to the lower animals, and to receive from them certain diseases, such as hydrophobia, variola, &c., therefore "this fact proves the close similarity of their tissues and blood." Here we have an instance of the small reliance to be placed upon such general statements as the above. Although there may be a strong resemblance between the blood of the higher Mammals and that of man, it does not follow that the one was produced by the other.

We are next supplied with "some trifling facts to prove how similar the nerves of taste must be in monkeys and in men." The natives of North-East Africa adopted the plan of catching wild baboons by first making them drunk. Vessels containing strong beer are placed in the way of the baboons. The poor creatures get tipsy and behave in a most strange manner. They are caught, and when sobered down on the following morning, look very cross and dismal. They hold their aching heads, and wear a most pitiable expression; and, when beer or wine is offered to them, they turn away with disgust, but will relish the juice of lemons. Another still more striking instance is that of "an American monkey, which, after getting drunk on brandy, would never touch it again, and thus was *wiser* than many men." What a theme for a moralist such facts would prove; but how weak a link in the argument that man has descended from an ape. The story of this American monkey would prove a valuable fact

if we were to attempt to demonstrate the opposite theory, that monkeys had descended from men. Here, whilst discussing the physical basis of the evolution theory, we might expect an array of incontrovertible facts, followed by close inductive reasoning, instead of which Mr. Darwin merely accumulates a variety of points of general similarity between the human frame and that of animals. He dwells on the presence in man of rudiments representing organs which exist in other species, and on the tendency of such rudiments occasionally to develop into more complete instances of such organs.

The drawing which Mr. Darwin gives of the embryos of a man and a dog, intended to show the "striking resemblances between man and the lower animals," is an utter failure; for, to an ordinary observer, the points of difference are strikingly obvious. But, even were they perfectly alike to the superficial observer, we should still believe there was some radical difference in their primary elements, knowing that they develop into such varied forms. The duty of science is to reveal hidden differences by means of the microscope and chemical analysis, and not to build vast theories on superficial resemblances. What would be thought of an astronomer who, in attempting to demonstrate the movements of the heavenly bodies, were to lay aside his telescope and mathematics, and present merely a sketch of the phenomena as they appear to the naked eyes. Assuredly,

this great problem of the origin of man, if it is ever to be solved, must be done on a more sure and scientific basis than has yet been attempted by Mr. Darwin.

The human ear is next the subject of investigation, and as it is conspicuously unlike those "pointed ears" of our great monkey progenitor, we might naturally expect some theory at least to account for the difference. But Mr. Darwin cannot say why man has lost the power of erecting his ears, but he offers a suggestion worthy of our deepest attention—namely, that our monkey forefathers, on account of their great strength and their arboreal habits, were not much exposed to danger, and so, through a lengthened period, scarcely moved their ears, and, on account of this neglect, lost the use of moving them.

Then we come to a piece of startling evidence that man once had "pointed ears." Mr. Woolner, the celebrated sculptor, whilst at work on his figure "Puck," to which he gave pointed ears, carefully studied the ears both of men and monkeys, and discovered that in some human ears there was a "little blunt point" projecting from the inwardly folded margin. Mr. Darwin's attention having been called to this little point, he at once concludes that "the meaning of these projections is not doubtful;" or, in plain words, there he finds the vestiges of the pointed ears man formerly possessed, and which now occasionally reappear. If this theory is considered satisfac-

tory and conclusive, we have at last found some evidence that man has descended from a monkey. It is remarkable, however, that so many awkward problems present themselves for solution before we can bring our minds to adopt the "development" theory. Man differs in a conspicuous degree from all other animals, in being almost without hair, except on the head and face, and also in being devoid of a tail. Two very awkward appendages to get rid of merely by selection; but firm faith in the evolutionary doctrine will overcome many difficulties. It is said that Lord Monboddo had a plausible theory to account for our ancestors having lost their tails, which was, that by continually sitting on them, they wore them completely off, after which our tails never grew again. Then, in reference to the loss of hair on the body generally, which our forefathers sustained, we wish it could be as easily accounted for as the loss of the tail.

An ardent "evolutionist" has offered a suggestion worthy of notice. Mr. Wallace believes "that some intelligent power has guided or determined the development of man," and he considers the hairless condition of the skin as coming under this head. Mr. Darwin quotes those words apparently to help him out of the enormous difficulty of accounting for it by "natural selection," knowing well that the "natives in all countries are glad to protect their naked backs and shoulders with some slight covering." Mr. Darwin then remarks that, "no one supposes that the naked-

ness of the skin is any *direct advantage* to man, so that his body cannot have been divested of hair through natural selection." And still further, he candidly acknowledges that neither conditions of climate nor correlated development will account for the loss of hair in the human species. The simple fact is, that on the "development" theory it is utterly inexplicable.

We are now entitled to ask, before leaving this part of the subject, what has Mr. Darwin proved from the three classes of facts adduced by him. We answer, literally nothing. Both facts and arguments are against him. In reviewing the arguments that, because man and the lower animals have limbs somewhat similar to each other, that their blood and tissues are not unlike, that they are liable to similar diseases, and possess rudiments which seem to show a close connection between them, we feel that the facts and reasoning therefrom are altogether inadequate to support the theory of "evolution." Indeed his arguments on this point seem to be singularly wanting in force and conclusiveness, and, as in the instances given on embryology, the arguments confute themselves by their absurdity and superficiality. And because we demur to the conclusions arrived at by Mr. Darwin he attributes our unbelief to "natural prejudice and that arrogance which made our forefathers believe they were descended from demigods."

Such language may be considered "scientific;"

but it is certainly not convincing. On the evolution principle difficulties seem to vanish as with the rod of an enchanter, for, remarks Mr. Darwin, "we have only to suppose" certain things, "then we can understand" how certain other things occurred, and "why it came to pass" that so and so happened. Thus, after heaping supposition upon supposition, we arrive at the grand conclusion, and are urged "frankly to admit" that we have all descended from a hairy animal with pointed ears and a tail. For any naturalist to hold aloof from such a belief till convinced by fact and argument, seems strange to Mr. Darwin and almost incredible; for he says that "to take any other view" than the development theory "is to admit that our own structure, and that of all the animals around us, is a mere snare laid to entrap our judgment." Are we to understand from these words that when we meet with difficulties in natural science we are to consider them as intellectual sign-posts advisedly put there to lead our understanding astray? Or, on the other hand, to resolve them only by the new and facile method of supposition and imagination? To take one more instance of this style of argument, Mr. Darwin tells us that he finds it impossible to explain the similarity between the hand of a man or a monkey, the foot of a horse, the flipper of a seal, and the wing of a bat, except upon the theory of development. If we say that they have all been formed upon the same general plan, which seems a reasonable expla-

nation, Mr. Darwin replies that such an answer is not a *scientific* explanation," which is quite true, if we assume that the "development" theory alone is scientific. But that is the very question to be proved. As to whether it is scientific or not to believe certain theories, depends upon whether those theories are *true* or not.

In the next chapter we shall pursue our inquiry into the evidence that can be adduced in favour of the process of development.

CHAPTER III.

ON THE DEVELOPMENT OF SPECIES.

IS it a matter of *fact* that species have been developed by force of circumstances from other species, and that man has descended from an ape or a monkey? We believe the theory to be totally unfounded from a scientific point of view, and therefore, when Mr. Darwin assumes the development theory to be scientific, his arguments fail in their force and conclusiveness. Indeed, he so often uses such phrases as "what may have been," or "can be," or "I cannot believe," as to betray his own consciousness of the want of sound scientific argument. And yet after much hesitation, doubt, and difficulty, he arrives triumphantly at the conclusion that "Man *has* certainly descended from some ape-like creature," whilst at the same time he has failed to prove one single instance of a clearly distinct species having been developed into another species. "We cannot believe," to use the "scientific" language of Mr. Darwin, that the poor Ascidians ever grew into fish, or that fish ever grew into frogs, or frogs into mammals, birds, and reptiles, or that lemurs grew into monkeys,

and monkeys into men, until we have some evidence that one species may develop into another. Horses remain horses, in spite of their vast varieties; and sheep will continue to be sheep through numberless variations; and pigeons, with all their remarkable differences, will never be anything but pigeons; and monkeys, baboons, and apes, in spite of all that can be done to elevate them mentally, morally, and physically, will remain to perpetuate their species and transmit to their successors all the marks of their lowly origin. We are not alone in our belief that Mr. Darwin has failed in his task of proving that man has descended from some lower form of organised existence. Some of the most eminent scientific men of the present day are entirely opposed to Mr. Darwin's theory, whilst several of those who believe in it think that he carries it too far.

Professor Huxley, an ardent supporter of the development theory, writes in a tone of less confidence than Mr. Darwin,* "After much consideration, and with assuredly no bias against Mr. Darwin's views, it is our clear conviction that, as the evidence stands, it is not absolutely proven, that a group of animals, having all the characters exhibited by species in nature, has ever been originated by selection, whether artificial or natural. Groups having the morphological character of species, distinct and permanent races in fact, have been so produced over and over again; but

* Professor Huxley's *Essays, &c.* 1870.

there is no positive evidence, at present, that any group of animals has, by variation and selective breeding, given rise to another group which was even in the least degree infertile with the first. Mr. Darwin is perfectly aware of this weak point, and brings forward a multitude of ingenious and important arguments to diminish the force of the objection. We admit the value of these arguments to their fullest extent—nay, we will go so far as to express our belief that experiments, conducted by a skilful physiologist, would very probably obtain the desired production of mutually more or less infertile breeds from a common stock in a comparatively few years; but still, as the case stands at present, this little 'rift within the lute' is not to be disguised nor overlooked."

He owns to a "little rift within the lute," which, alas! is more than sufficient to spoil the finest harmony of the Darwinian theory. As the case now stands, by the admission of such an authority as Professor Huxley, no definite proof has yet been obtained that the limits of true species have ever been passed. This admission is so far important that it shows that the views of those who assert the independence of species are in harmony with the teachings of science and the facts of our present knowledge; and still further, it is evidence that those who hold the doctrine of evolution are, in one of its most important points, unsupported by evidence.

Is it not surprising then, that with such a com

plete flaw in the argument, a man of high scientific attainments like Mr. Darwin should speak as we have seen of man having *certainly* descended from an ape? There appears to be a complete misapprehension of the argument from approximation. It seems tacitly assumed that *mere approximation*, provided that it can be carried sufficiently close, implies in itself ultimate coincidence. Thus the whole theory of Darwinism is founded on general resemblances in the variations of different species. Otherwise Mr. Darwin would be able to say, "Here is a case of one true species having developed into another; here is the practical proof that approximation ends at last in coincidence." But this is precisely what Mr. Darwin is unable to do, and therefore the whole theory of likeness in bodily structure is totally unworthy the reliance Mr. Darwin so confidently places upon it.

CHAPTER IV.

THE MENTAL POWERS OF MAN AND ANIMALS.

AFTER the disappointment we have experienced in examining all that could be adduced as evidence that man has descended from an ape, we turn with pleasure from the consideration of man's physical structure and rudiments to hear what can be said of the mental relationship of man to the lower animals. In the opening words of this chapter, Mr. Darwin appears fully to appreciate the difficulties of the task he has undertaken, and at once acknowledges, with philosophical candour, that there is an "enormous" difference between the mind of one of the lowest savages and that of the most highly organised ape. And still further states, that "the difference would, no doubt, remain immense, even if one of the higher apes had been improved or civilised as much as a dog has been in comparison with its parent form, the wolf or jackal." So far we are fully in accord with Mr. Darwin, and from the illustrations which follow these propositions, we think that we have not misapprehended his idea. He tells us that "the Fuegians rank among the

lowest barbarians," and then remarks with what surprise he observed that three of these said "lowest barbarians," after a little intercourse with Europeans, "resembled us in disposition and in most of our mental faculties." This testimony is most important, and bears directly upon the point under discussion, and proves, beyond doubt, that the lowest savage possesses a mind and an intellect similar in *kind* to that of the most civilised races of men. After thus stating so explicitly and so admirably his leading propositions, Mr. Darwin gives us, in language no less plain, his crucial test.

"If no organic being excepting man had possessed any mental power, or if his powers had been of a wholly different nature from those of the lower animals, then we should never have been able to convince ourselves that our high faculties had been gradually developed." We have thus far on this topic followed Mr. Darwin with intense interest and pleasure, and now with a clear issue before us we await the evidence that is to prove that there is no fundamental difference between man and the higher class of animals, such as apes and monkeys. But before proceeding further we are bound to notice a fallacy of reasoning, so obvious indeed that it scarcely needs exposure. It is in the ambiguous use of the term "mental power," where in the first instance it means *instinct*, and evidently in the second *reason*. The phrase we object to is this, that "there is a much wider interval in mental power between

one of the lowest fishes, as a lamprey or lancelet, and one of the higher apes, than between the mental power of an ape and man; yet this immense interval is filled up by numberless gradations." We admit most readily that there is an "immense interval" between the *instinct* of a lamprey and that of an ape, and that this great interval can be filled up by "numberless gradations," but the question is altogether different when a comparison is made between the "mental power" of an ape and that of a man. If by the phrase "mental power," Mr. Darwin means *reason*, then he is comparing instinct with reason, two decidedly different things; or if he intended it to mean *instinct*, then the interval between man and some of the higher animals is not "immense," for man is surpassed in *instinct* by many of the lower animals: so much so that Cuvier maintains that instinct and reason stand in an inverse ratio to each other, or that animals with most reason have least instinct, and those with most instinct are possessed of the least faculty for reasoning.

We thus leave Mr. Darwin on the horns of this dilemma without feeling bound "to admit" that the "immense interval," between the instinct of an ape and the reason of a man, can be bridged over by a comparison with things so totally different. To have compared the instinct of a fish and an ape, and the reason of a savage with that of a philosopher, would have been just. But to attempt to overleap the immense chasm between

instinct and *reason* by the use of an ambiguous term, could not be passed by without notice, especially, as Mr. Darwin informs us, that his "object in this chapter is solely to show that there is *no fundamental difference* between man and the higher mammals in their mental faculties."

Beginning with the lowest forms of life, we inquire what Mr. Darwin has to say of the development of their "mental powers," when, to our astonishment, we are plainly told that there is no evidence whatever to be obtained, and that it is "as hopeless an inquiry as how life first originated." We begin to feel disappointment when Mr. Darwin says, "it would be superfluous to enter into many details on this head," and that this part of the subject "must here be treated briefly." At least, we might have expected that a well-developed imagination would have constructed as plausible a theory on the "evolution" of the intellectual faculties as that given on the bodily structure, and, still more, that we should have had an accurate and a philosophical analysis of the mental powers, both of man and the higher mammals. Then we ought to have been conducted onwards by cogent reasoning, based on well-ascertained facts, and numerous details to have brought us to a logical and an irresistible conclusion, that "there is no fundamental difference" between the mind of a man and that of an ape.

Mr. Darwin evades the real difficulties of the

question respecting the early development of the mental powers, by telling us that they are "problems for the distant future, if they are ever to be solved by man;" but, at the same time, promises "to give some additional facts under sexual selection, showing that the mental powers of animals very low in the scale are higher than might have been expected." Thus, signally failing to grapple with this important part of the subject, we pass on, over a vast gulf, finding nothing but a few disconnected comparisons between some of the instincts and reasoning powers of the higher and lower class of animals, but in their import and bearing altogether inconclusive. For instance, Mr. Darwin acknowledges that man has fewer instincts than the ape, and the baboon, and other animals high in the scale, and gives an instance of the remarkable instinct displayed by the chimpanzee, which is a native of Africa, and the orang, which inhabits the islands of Eastern Asia. Though widely separated from each other in point of distance, it is a remarkable fact that they build platforms on which they sleep, very similar to each other in shape and construction. As there is no possibility of one set of animals teaching the other, and as they go on from generation to generation building in the same manner, we not unreasonably conclude that both the orang and chimpanzee build their platforms from instinct, just as birds of the same species build similar nests whether they are in England or Australia. But Mr. Darwin "cannot feel sure"

but that it may arise from these "animals having similar wants, and possessing similar powers of reasoning." If, however, any distinction is to be kept up between the power of instinct and that of reason, we must unhesitatingly place such instances under the term instinct. Again, in the case of apes and monkeys which avoid the many poisonous fruits of tropical climates,—a fact we attribute solely to instinct, though, as before, Mr. Darwin "cannot feel sure" that these animals do not learn "from their own experience, or that of their parents."

We are now glad to escape from this "cannot feel sure" mode of reasoning, and to arrive at something positive on the subject of instinct, for Mr. Darwin tells us, "it is *certain* that apes have an instinctive dread of serpents, and probably of other dangerous animals."

But the question of Instinct will be more fully discussed in the following chapter, whilst comparing the reasoning and instinctive powers of man and the lower animals.

CHAPTER V.

ON INSTINCT AND REASON.

AS Mr. Darwin had so fully discussed the question of Instinct in the *Origin of Species*, we could hardly expect so lengthy a disquisition upon that question, except in its relation to the thinking and reasoning powers of man, in the *Descent of Man*. However, the important subject of instinct is far too lightly treated, and, indeed, is so much passed over, that we have to turn to the former work to ascertain precisely what Mr. Darwin's views on instinct are, and here we find a most remarkable admission, strongly opposed to the idea of development. He writes thus:* "It would be the most serious error to suppose that the greater number of instincts have been acquired by habit in one generation, and then transmitted by inheritance to succeeding generations. It can be clearly shown that the most wonderful instincts with which we are acquainted,—namely, those of the hive-bee, and of many ants,—*could not possibly have been acquired.*" Such an admission is, of itself, fatal to the whole theory of evolution.

* *Origin of Species.* Third Edition. P. 229.

Referring again to the *Origin of Species*, we find an excellent definition of instinct, as "an action which we ourselves should require experience to enable us to perform, when performed by an animal, more especially by a very young one, without any experience, and when performed by many individuals in the same way, without their knowing for what purpose it is performed, is usually said to be instinctive." We accept this as a fair statement of what is understood by instinct, and we now ask Mr. Darwin on what principle he can bridge over this vast gulf between reason and instinct, or how instinct could have been developed into reason. We find no answer to such a question in the *Descent of Man*. We can make great allowances to Mr. Darwin on account of his intense love of natural history, his close and accurate observation, and above all his admirable style of describing the habits and instincts of animals. His description and explanation of the cell-making instinct of the hive-bee is remarkable. Mr. Darwin thinks the man must be dull indeed who can examine the exquisite structure of a comb without being excited to enthusiastic admiration, and yet but the work of instinct. A matter for still greater wonder is that "bees have practically solved a recondite problem, and have made their cells of the proper shape to hold the greatest possible amount of honey, with the least possible consumption of precious wax in their construction." Yes, by *instinct* the bee has accom-

plished a work that a skilful artizan, with proper tools and appliances, would find it difficult to equal in full daylight, though the comb is made by a crowd of bees in a dark hive. In fact, Mr. Darwin admits that "the comb of the hive-bee, as far as we can see, is absolutely perfect in economising wax." And it is the acquirement of such an instinct as this that cannot be explained by either natural or sexual selection.

Let us now patiently examine what can be said in favour of the lower animals, possessing even in a small degree those intellectual powers which place man so far in advance of all other organised beings. On this point Mr. Darwin remarks, that "of all the faculties of the human mind, it will, I presume, be admitted that *reason* stands at the summit." We are then reminded that few persons doubt that "animals possess some power of reasoning." As proof of this, "animals may constantly be seen to pause, deliberate, and resolve." And further, Mr. Darwin adds, that the more naturalists study the habits of animals, the more they attribute to reason and the less to unlearnt instincts. Several instances are then given as examples or illustrations of the reasoning powers of monkeys and dogs. These stories are well authenticated, as indeed, all Mr. Darwin's are; at the same time, we believe them totally inadequate to substantiate the point at issue. It is stated by Rengger, that when he first gave the monkeys some eggs, they hastily seized them, and thus smashed them,

losing much of their contents; afterwards they learnt to take the eggs more carefully, and to break them by tapping one end gently against some hard body, and then picking off the bits of shell with their fingers. In another instance, when a monkey had cut himself with a sharp-edged tool, he would not touch it again, or, if he did, would handle it most carefully. Lumps of sugar wrapped in pieces of paper were given to the monkeys, which they ate greedily; but when a live wasp was put in with the sugar, the monkeys were stung, after this they were more cautious, and held up the packet to their ears before opening it, to detect any movement in it.

After giving the instances just related, Mr. Darwin, as we think, too suddenly jumps to a conclusion, and thus remarks that "anyone who is not convinced by such facts as these, and by what he may observe with his own dogs, that animals can reason, would not be convinced by anything that I could add." As we are not aware what Mr. Darwin *could have added*, either by way of fact, argument, or illustration, we may reasonably conclude that he has said the best things he could in support of his theory. "Nevertheless," he adds, "I will give one case with respect to dogs, as it rests on two distinct observers, and can hardly depend on the modification of any instinct." As this "case" has been cited, and great stress laid upon it as proving that dogs at least possess reason, we feel bound to narrate the story. It

appears that two wild ducks had been winged and fell on the opposite side of a stream, a retriever tried to bring over both ducks at once, but as she could not succeed, she deliberately killed one and brought over the other, and then returned for the dead bird; and the fact of her killing one was the more remarkable as before she had never been known to ruffle a feather. At first sight this seems a "case" of reasoning, till we remind ourselves of the powerful instincts of dogs not to allow the game to escape; and we see at once that it was a remarkable instance of *natural instinct* prevailing over the influence of the training the dog had received never to ruffle a feather. This view of the case is strongly confirmed by another story, where two partridges were shot, one being killed and the other wounded; the latter ran away and was caught by the retriever, who on her return came across the dead bird. She stopped, evidently greatly puzzled, and after one or two trials, finding she could not take it up without permitting the escape of the winged bird, she considered a moment, then deliberately murdered it by giving it a severe crunch, and afterwards brought away both together. This was the only instance of her ever having wilfully injured any game." Upon this instance Mr. Darwin remarks: "Here we have reason, though not quite perfect, for the retriever might have brought the wounded bird first and then returned for the dead one, as in the case of the two wild ducks." And had there been any play of

reason we say that is exactly what the retriever would have done. But, as in the former case, strong natural *instinct* not to allow the bird to escape prevailed over the *habit* she had of bringing to her master the game uninjured. If such instances as these are the strongest evidences that can be brought to prove the kinship of man to the brutes, we fear that Mr. Darwin will not only fail to gain converts to his theory, but will rather confirm his readers in the belief that there *is* a fundamental difference between the mental powers of man and the lower animals. We should also remember, in considering such cases as the preceding, that *instinct* alone will enable some of the lower animals to do what man could not do without much thought and reasoning. In fact this is the true distinction between *instinct* and *reason* that the lower animals do what to *reasoning man* appears marvellous. A dog tracking his prey by the acute sense of smell will far surpass the utmost exertions of human sagacity.

CHAPTER VI.

ON THE MENTAL POWERS—(*continued*).

IN reference to the higher mental qualities of "abstraction, individuality, and self-consciousness," Mr. Darwin reasons thus: "It would be useless to attempt discussing these higher qualities, which, according to several recent writers, make the sole and complete distinction between man and the brutes, for hardly two authors agree in their definitions." But we see no reason in this, why Mr. Darwin should not have constructed his own theory as he does upon other matters without waiting for all authors to agree in their definitions of those high faculties, upon which all metaphysical writers *are agreed* that man *does possess*, and which place him so far above the brute creation. But he avoids the difficulty on account of "several recent writers, who cannot agree about the definition," and proceeds in his reasoning, by saying, "such faculties could not have been fully developed in man until his mental powers had advanced to a high standard, and this implies the use of a perfect language. No one supposes that one of the lower animals reflects whence he comes or whither

he goes—what is death, or what is life, and so forth." "But," continues Mr. Darwin, reducing his argument to an absurdity, "can we feel sure that an old dog with an excellent memory and some power of imagination, as shown by his dreams, never reflects on his past pleasures in the chase?—and this would be a form of self-consciousness." Such a course of reasoning, from the sublime downwards, needs scarcely a word of comment, for the development of a "perfect language" itself implies the use of those high faculties. For a language *without* being "perfect" is at once the expression and the instrument of thought, and therefore in the use of terms there must be notions in the mind to correspond to those expressions. From considering the development of thought we are thrown back to the development of language, and of necessity we are again thrown on the development of thought. This appears something like arguing in a circle. That so little can be said on this vital link in the chain which connects man with the lower animals, will strike with surprise many who are not believers in the theory of "evolution." And it is on this point that Mr. Darwin elects that his theory shall stand or fall; for if it can be shown that the mental powers of man are "of a wholly different nature from those of the lower animals, then," he says, "we should never have been able to convince ourselves that our high faculties had been gradually developed." A more complete and utter failure we can hardly imagine,

than Mr. Darwin has made in attempting to show that the difference in man's mental power with that of animals was only one of *degree* and not of *kind*.

We now pass on to consider what can be said of the emotional faculties of the mind, "which are very important as forming the basis for the development of the higher mental powers." It is said that animals enjoy excitement and suffer from *cnnui*, as may be seen from dogs and monkeys. All animals feel wonder whilst many exhibit curiosity. The possession of the latter quality often causes them to suffer, as the hunter plays tricks with them, attracts, and catches them. This happens with deer, wild ducks, and even the wary chamois. Monkeys have an instinctive dread of snakes, and yet their curiosity often tempts them to satisfy their horror in a most human fashion. Mr. Darwin was so much surprised at the accounts he heard of their dread of serpents and of their curiosity to inspect them, that he determined to try some experiments on this point. Accordingly, he took a stuffed and coiled up snake into the Monkey-house at the Zoological Gardens, and the excitement thus caused was one of the most curious spectacles which he ever beheld. Some of the monkeys, excited and alarmed, dashed about their cages and uttered sharp signal cries of danger, which were understood by the other monkeys. A few young monkeys and one old baboon alone took no notice of the snake. Mr. Darwin then placed the stuffed specimen on the ground in one of the

larger compartments. After a time all the monkeys collected round it in a large circle, and staring intently, presented a most ludicrous appearance. They became extremely nervous, so that when a wooden ball, with which they were familiar as a plaything, was accidently moved in the straw, under which it was partly hidden, they all instantly started away. These monkeys behaved very differently when a dead fish, a mouse, and some other new objects were placed in their cages; for, though at first frightened, they soon approached, handled, and examined them. He then placed a live snake in a paper bag, with the mouth loosely closed, in one of the larger compartments. One of the monkeys immediately approached, cautiously opened the bag a little, peeped in, and instantly dashed away. Then monkey after monkey, with head raised high and turned on one side, could not resist taking momentary peeps into the upright bag, at the dreadful object lying quiet at the bottom. "It would almost appear," says Mr. Darwin, "as if monkeys had some notion of zoological affinities," for some exhibit a strange, though mistaken, instinctive dread of innocent lizards and frogs. "An orang, also, has been known to be much alarmed at the first sight of a turtle." We have given the foregoing instances almost entire, in order to show the kind of stories on which Mr. Darwin depends to produce conviction that the mental powers of man and the brutes are not so much unlike.

The principle of *Imitation* is strong in man, especially amongst men in a barbarous state. Few of the lower animals voluntarily imitate actions performed by men until in the ascending scale we come to monkeys, which are well-known to be ridiculous mockers. "Birds imitate the songs of their parents, and sometimes those of other birds, and parrots are notorious imitators of any sound which they often hear." Mr. Darwin lays great stress upon the power of *Attention* which some animals manifest; as when a cat watches by the hole of a mouse, and prepares to spring on its prey. Then he remarks that most animals possess good *Memories* for persons and places, and tells us of a baboon that recognised its master, after an absence of nine months. A still stronger instance of the power of memory is given of a savage dog belonging to Mr. Darwin, which recognised him after an interval of five years and two days. Even ants know their fellow-ants after an absence of four months. Then Mr. Darwin makes a remark to which we can furnish an apt illustration. He says that "animals can certainly, by some means, judge of the intervals of time." For four nights in succession, whilst writing this book, a mouse has come and gnawed at the wainscotting, at about a quarter past eleven, and has not varied more than five minutes each evening. On the fourth evening, on hearing the sounds, I exclaimed involuntarily, "It is a quarter past eleven." It was, however, three minutes past that time, and I was

ready to blame the mouse for a want of punctuality, but the next day I ascertained that the clock was a few minutes fast, and therefore I wish to give the mouse full credit for its regularity of habits, and as Mr. Darwin would put it, "judging properly of the intervals of time."

Then, as regards the power of *Imagination*, Mr. Darwin attempts to show that many of the lower animals possess this power, and tells us that it is stated, on good authority, that dogs, cats, horses, and other of the higher animals, have vivid dreams. This, he thinks, "is shown by their movements and voice;" but as there is no evidence whatever of their having the faculty of imagination, we pass the subject by without further remark.

Having thus passed in review the emotional faculties of some of the higher animals, we must confess our surprise that so *little* has been told us that was new, and still more that that little fails to supply the materials for bridging over the chasm of fundamental differences between man and the brutes. If we grant that many animals do possess some emotions similar to man, such as wonder and curiosity, imitation, memory, and attention, what does it all prove, and of what avail to heap together mere stories and anecdotes of the instinct of monkeys, dogs, and birds? We admit most readily that dogs and monkeys do possess most remarkable instincts, but it is not by such instances as these that the views now generally held respecting the difference between the mental

faculties of men and animals can be overthrown. The proofs of such vast theories as that of evolution require infinitely more care and research than Mr. Darwin has bestowed on them to render them convincing; and we can, therefore, readily endorse his own words, when he tells us that those subjects, though of the highest interest, are treated by him in "a most imperfect and fragmentary manner."

It is a fact not to be overlooked, that of all animals, "*Man alone* is capable of progressive improvement." The human mind is capable of almost indefinite expansion, whilst the mental faculties of the lower animals are restricted and definite. The marvellous power of abstraction and generalisation, of which an educated man is capable, takes us far above the region of the highest animal instincts, and forces on the mind a conviction of an *essential difference* between the mind of man and the instinct of animals. Mr. Darwin struggles in vain against this objection by adducing such weak illustrations of the expansive power of brute intellect as that old animals are more difficult to catch or to poison than young ones; yet, as all have not partaken of the poison, or had their own feet in the trap, he thinks that they must learn caution from "their brethren." "Our domestic dogs are descended from wolves and jackals; and though they may not have gained in cunning, and may have lost in wariness and suspicion, yet they have progressed," Mr. Darwin

believes, "in certain moral qualities, such as in affection, trustworthiness, temper, and probably in general intelligence." These instances go far to prove the limit and boundary there is to the intelligence of the lower animals, and, consequently, the impassable gulf between them and man.

A striking illustration of the limited mental power of animals is seen in the fact that no instance was ever known that an animal fashioned a tool. This is an important distinction between using a tool, as some animals may be seen to do. The chimpanzee will crack a nut, like a walnut, by using a stone. Some birds will break the shells of snails by dashing them on a large stone. We are then told of a sagacious monkey that hid the stone which he used for cracking nuts. These are mere instances of the power of instinct; but, beyond this, animals do not go. They never shape an implement for any purpose whatever. To fashion an instrument for a particular purpose is absolutely peculiar to man. Mr. Darwin admits that this "is no doubt a very important distinction," and then takes refuge in a "suggestion" of Sir John Lubbock's, "that when primeval man first used flintstones for any purpose, he would have accidentally splintered them, and would have then used the sharp fragments." Granting that this accidental breakage might take place, the essential point is still left unexplained how man came *designedly* to manufacture tools for special purposes; but Mr. Darwin continues, "From this step it would be

a small one to intentionally break the flints, and not a very wide step to rudely fashion them." These small steps are just the points Mr. Darwin fails to substantiate either by fact or argument.

"The art of making fire" is a still greater puzzle to believers in the "evolution" doctrine, for it is a notorious fact that animals have an instinctive dread of fire, and travellers often secure themselves from the attacks of wild beasts by making large fires. How, then, is it probable that any animal progenitors of ours should so overcome their instincts as to discover the use of fire and the art of making it. If we ask *when* this took place, Mr. Darwin replies, "This last discovery, probably the greatest, excepting language, ever made by man, dates from before the dawn of history." "*Before the dawn of history*,"—a safe place in which to relegate all difficult and unsolvable questions is the limbo of untold ages and remote periods. Sir John Lubbock's testimony on this point is very important, as showing the general use of fire among the rudest tribes, and the utter improbability of its being discovered by any mere ape-like creature in the early days of development.

Sir John remarks,* that "it cannot be satisfactorily proved that there is at present, or has been within historical times, any races of men entirely ignorant of fire. It is at least certain that, as far back as the earliest Swiss lake-villages, and Danish

* *Pre-historic Times.* Second Edition. P. 548.

shell-mounds, the use of fire was well-known in Europe."

Taking this testimony, which is unimpeachable, the argument derived from the fact that MAN, in the earliest known ages, used fire; whilst unreasoning animals, that are guided solely by instinct, do not, and never did use fire, tells sadly against the theory of development.

CHAPTER VII.

ON LANGUAGE.

WE now pass to the great and all-important question of language, which we think might fairly have claimed from Mr. Darwin one chapter for its discussion, instead of the subject having been crowded into a few pages in the middle of a chapter on the "Mental Powers;" especially as Mr. Darwin does not underrate its importance and bearing on the great question before us: for, in the opening sentence, we most cordially agree with his view, that "this faculty has justly been considered as one of the chief distinctions between man and the lower animals." And, whatever may be said of the noises made by animals, such as the barking, yelping, howling, and growling of dogs as a kind of language in which they express their ideas of joy or anger, we still see a radical difference between the articulate language of man, and the cries of the lower animals.

Mr. Darwin, however, further states that, "It is not the mere power of *articulation* that distinguishes man from other animals, for, as everyone knows, parrots can talk; but it is his large power

of connecting definite sounds with definite ideas, and this obviously depends on the development of the mental faculties." Here we have another instance of the way in which Mr. Darwin escapes from a difficulty he recognises, by running away to some other difficulty. If, for instance, "articulate language is peculiar to man," of what value is it in solving the difficulty to say that in other respects man and animals are alike. Our cries of fear, pain, and joy, may be similar in some respects to the cries of animals, but that does not in the slightest respect touch the great question of *articulate speech* so eminently characteristic of man. Still further, we would ask, what is the nature of those "mental faculties" which render definite ideas possible? Mr. Darwin tells us that the chief characteristic of language is the power of connecting definite sounds with definite ideas, and this admission renders the whole of his discussion on the growth of the act of giving vent to emotions in sound entirely beside the mark. Of what use to inform us that some monkeys can make as many as six distinct sounds, and dogs four or five, when he admits that such sounds are not articulate language at all, but the mere expression of passing emotions. To follow Mr. Darwin in his reasoning, we find that the essential element in speech is not the mere expression of a single emotion or idea, but the expression of the *relation* one idea bears to another.

It is not the bare utterance of the noun alone, as

he would acknowledge, that constitutes the true characteristic of speech, but the verb accompanying; they form together a sentence, or, in other words, "articulate language." On this ground the talk of parrots cannot be called "language," for no one would argue, that when parrots talk, it is connected with any intelligible idea in the brain, but a mere imitation of sounds they have heard. To reason logically from Mr. Darwin's own definition of articulate language, would totally exclude the cries and noises made by animals from being understood, in the least degree, as speech. Without ideas mere words have but little weight, as in the case of the parrot; and, without speech, knowledge is of little value. The union of these in their highest perfection, we find in man, and in man only. In this strong characteristic we see a "fundamental" difference between man and the lower animals. Respecting the *origin* of language, Mr. Darwin tells us, that he "cannot doubt that language owes its origin to the imitation and modification, aided by signs and gestures, of various natural sounds, the voices of other animals, and man's own instinctive cries." And that, probably, our primeval parents, or some early progenitors of man, in those far-off distant ages before the dawn of history, used their voices largely in singing, or to speak with more exactness, in producing "true musical cadences like the gibbon-apes at the present day." Then the imitation of musical sounds might have given rise to words expressive of various

complex emotions. "As monkeys understand much that is said to them by man, and as in a state of nature they utter signal cries of danger to their fellows, it does not appear altogether incredible, that some unusually wise ape-like animal should have thought of imitating the growl of a beast of prey, so as to indicate to his fellow-monkeys the nature of the expected danger. And this," Mr. Darwin concludes, "would have been a first step in the formation of a language." Then, "as the voice was used more and more in growling, the vocal organs would have become strengthened and perfected through the principle of the inherited effects of use, and this would have re-acted on the power of speech." Then, remembering the importance to be attached to mental development to aid in the perfection of speech, Mr. Darwin suggests that "the mental powers in some early progenitor of man must have been more highly developed than in any existing ape before even the most imperfect form of speech could have come into use." And thus he goes on through a vast labyrinth of guesses, building his great theory upon suppositions, suggestions, and probabilities. One very strong objection we have to accepting Mr. Darwin's idea of the origin of language, is that it is so diametrically opposed to our knowledge and experience. For instance, let any naturalist take the most intelligent ape, baboon, chimpanzee, orang, gorilla, mandrill, or monkey that can be found, and attempt to train him to use articulate

language, and the experiment, like others of a similar kind, will utterly fail. If, then, with all the advantages of training by a highly developed man, this should fail, it seems extremely improbable that a less organised animal, without the advantages of training and example, should rise unaided to the top of the scale of animated existences. To put faith in such vast improbabilities requires a large amount of credence.

CHAPTER VIII.

THE MORAL SENSE, OR CONSCIENCE.

IN still further comparing the mental powers of man and the brute creation, Mr. Darwin tells us that he "fully subscribes to the judgment of those writers who maintain, that of all the differences between man and the lower animals, the moral sense or conscience is by far the most important." But as the moral sense can only exist in connection with human reason, and Mr. Darwin has failed entirely to show that man's mental powers are similar to that of the lower animals, it seems almost superfluous to go on discussing speculations on the development of conscience. Still, in justice to Mr. Darwin, we will state his leading propositions, and hear what can be said in their support. After endorsing the words of Mackintosh that the moral sense "has a rightful supremacy over every other principle of human action," he adds that it may all be summed up in one short but imperious word *ought*, so full of high significance. We then have Mr. Darwin's cardinal proposition on this subject. He thinks that it is highly probable "that any animal what-

ever, endowed with well-marked social instincts, would inevitably acquire a moral sense or conscience as soon as its intellectual powers had become as well developed, or nearly as well developed, as in man." For "the social instincts would lead an animal to take pleasure in the society of its fellows, and to feel a certain amount of sympathy with them." Then, "as soon as the mental faculties had become highly developed, images of all past actions and motives would be incessantly passing through the brain of each individual, and that feeling of dissatisfaction which invariably results from any unsatisfied instinct, would arise." "After the power of language had been acquired, and the wishes of the members of the same community could be distinctly expressed, the common opinion how each member ought to act for the public good, would naturally become, to a large extent, the guide to action."

Added to these, "*habit* in the individual would ultimately play a very important part in guiding the conduct of each member; for the social instincts and impulses, like all other instincts, would be greatly strengthened by habit." Thus it is clear, from these propositions, that Mr. Darwin accounts for the moral sense or conscience by the simple process of animals living together and having their minds educated or developed. Therefore "any animals whatever" that might herd together in social harmony would soon acquire a *conscience*, providing at the same time their mental powers

could be sufficiently expanded. It is somewhat surprising that, with all the social instincts that monkeys possess, not to mention the chimpanzee and the ape, that, no tribe of wild animals should ever have acquired that which above all other things distinguishes man from the brute. If the propositions we have quoted are intended as an exposition of the development of the moral sense in man, the essential peculiarity of that sentiment is left wholly unexplained. What should have been explained is not the sense of dissatisfaction arising when the social instinct has been disregarded, but the dissatisfaction which is wholly different from that which arises from the disappointment of other instincts. The feeling that we have wilfully done wrong is totally different from the feeling that we have fallen into an error, however grievous. That which distinguishes conscience from all other faculties, is its high authority. Conscience sits as a judge, and, without reasoning, determines what is right and wrong. But Mr. Darwin's exposition of conscience is that the social instinct may be developed into feelings of doing that which is *desirable*, and that this moral instinct works mainly by the threat of *dissatisfaction*, aided by habit, experience, and inherited tendencies.

But if conscience be merely an instinct educated into the feeling of doing what is desirable for the good of the community, why does he quote with admiration Kant's words: "Duty! wondrous thought, that workest neither by fond insinuation,

flattery, nor by any threat, but merely by holding up thy naked law in the soul, and so extorting for thyself always reverence, if not always obedience; before whom all appetites are dumb, however secretly they rebel." But Mr. Darwin has described a moral sense or conscience the very reverse of this noble sentiment. He has described a highly-developed appetite, but not a supreme self-asserting authority. The former is conceivable in animals, of the latter there is not a trace among them :—

> "The conscience, that sole monarchy in man,
> Owing allegiance to no earthly prince;
> Made sacred, made above all human laws,
> Holding of Heaven alone; of most divine
> And indefeasible authority."

Such a view of conscience would hardly be accepted by Mr. Darwin, as it would be extremely difficult to reconcile it with the principle of an educated and developed instinct. Mr. Darwin is candid enough to own that it is not without hesitation that he ventures to differ from so profound a thinker as John Stuart Mill, who, in his work on *Utilitarianism*, expresses his belief that "the moral feelings are *not* innate, but acquired; though they are not for that reason less natural." On this Mr. Darwin remarks that "the *social feelings* are instinctive or innate in the lower animals, and why should they not be so in man?" Why not, indeed, if only to favour the evolution theory!

Even Mr. Bain and other writers on mental and

moral science, express their belief that the moral sense is not inherited but acquired by each individual during his lifetime. This testimony is exceedingly unfortunate for Mr. Darwin, as it cannot, under any circumstances, be reconciled with the innate conscience theory.

CHAPTER IX.

ON RELIGION.

UNSATISFACTORY as Mr. Darwin's treatment of the moral sense has proved, his views on religion are still more to be deplored. A mere casual mention of religion as a civilising influence, or a brief reference to the belief in a Supreme Being and the immortality of the soul, is all that these important subjects receive at the hands of Mr. Darwin. Indeed, we ought not to be surprised at this; for, if man is a mere development from some lower animal, what need has he of a soul at all? "It is the atoms of the brain that think," said the Greek philosopher who first invented the development theory. And if man possesses no soul, why talk of its immortality? And if the universe, with all its wondrous organisms of vegetable and animal life, be the mere result of the operation of law without the guiding hand of a Supreme Being, what need of a God or a heaven? And if the development theory, as set forth in *The Descent of Man*, be true, there is but one logical conclusion to the whole matter—that is, that the Bible is a myth, religious faith merely an

"ennobling" fiction, and all our theology and belief in a Divine Being a splendid delusion. Such we repeat is the inevitable sequence of the doctrine of evolution.

We are aware that Mr. Darwin anticipates that this view will be taken of his theory, and that his conclusions will be deemed "irreligious." Then, by implication, he attributes to his opponents a belief in "blind chance:" one of the very few instances in which Mr. Darwin is wanting in candour to those who do not accept his theory of development. In *The Descent of Man** he says, "The births, both of the species and of the individual, are equally parts of that grand sequence of events, which our minds refuse to accept as the result of *blind chance*. The understanding revolts at such a conclusion." Who are those, we may ask, who believe in "blind chance?" Surely, not the "religious" man, who believes in a stronger sense, perhaps, than even Mr. Darwin, in the presence of an All-wise, Supreme Governor of the universe. It is the "religious" man who best sees and most fully realises that—

> "Not a flower
> But shows some touch, in freckle, streak, or stain,
> Of His unrivalled pencil."
> And "from the broad majestic oak,
> To the green blade that twinkles in the sun,
> Prompts with remembrance of a present God."

But the author of *The Descent of Man* pre-

* Part I., page 33.

dicts that "The time will before long come when it will be thought wonderful, that naturalists, who are well acquainted with the comparative structure and development of man and other mammals, should have believed that each was the work of a separate act of creation." And, if we were inclined to utter a prediction, we should say, in the same strain, "The time will before long come, when it will be thought marvellous that any philosophical naturalist should have believed in the imaginative story of man's evolution from the lowly form of a jelly-fish." But Mr. Darwin is not wanting in apologists for his theory, as may be seen in a recent article in an influential monthly.* This writer, under the signature of A. B., attempts to explain away the great fact that Darwinism is diametrically opposed to revealed religion. Not actively opposed, so much as that it undermines all belief in religion by taking away its foundations. Man is represented as a highly organised monkey or ape, and that again a mere development from a fish. With such a belief, what need of communion with God, and what of all the hopes and fears and the longings of the soul after a future life. And yet this writer, in a spirit of maudlin sensibility, would fain have us believe that the theory of Darwinism will not affect our belief in revelation, and writes an essay "to attempt to show, firstly, that the nobility of our conscience, as a gift from God, and our power of

* *Macmillan's Magazine, May*, 1871. "Darwinism and Religion."

communion with Him, are in no way impugned by this theory." That the conscience is a "gift from God," is an entirely new view of the Darwinian theory, which alike ignores the God of Creation and of Revelation. And yet A. B. tells us "that our hope of immortality stands on precisely the same basis" as before. We turn away from such weak attempts to reconcile what never can be reconciled, and would say with Lord Bacon, "It were better to have no opinion of God at all, than such an opinion as is unworthy of Him; for the one is unbelief, and the other is contumely."

CHAPTER X.

SUMMARY AND CONCLUSION.

AFTER a careful and patient survey of the whole theory of "development," as put forth by Mr. Darwin in his book of *The Descent of Man*, we arrive at but one conclusion—namely, that it is "not proven." We shall now, as briefly as possible, show the steps by which we arrived at this result. In our examination of this great question, we stated, at the outset, what it was that Mr. Darwin was attempting to prove. In the plainest possible language we tried to show that the "development theory" meant that, in the distant ages of the past, an animal like a tadpole grew and increased until it became a fish; then the fish went on developing until it grew into a frog; then the frog, in turn, began *slowly* to increase in size,—not like the ambitious frog in the fable that wanted to make himself all at once as large as the ox he saw grazing in the meadow, and blew and blew till he burst his skin, but slowly; from Mr. Darwin's frog we have developed the backboned animals, such as the kangaroo and the lemur; then the lemur grows into a monkey; and

the monkey into a man. Thus we have given, in brief terms, the pedigree of man, and instantly the questions arise, *where* and *how* and *when* did these great changes take place? "We are naturally led," says Mr. Darwin, "to inquire *where* was the birthplace of man" when he separated from the monkeys, and assumed his present elevated form. There is no doubt but that it was "the Old World," if anywhere; "but not Australia, nor any oceanic island," as that would not harmonise with the theory. Mr. Darwin's opinion is that the most probable place from which we sprung from the monkey tribe was Africa. But he reminds us that "it is useless to speculate on this subject," for a very large ape once lived in Africa which is now extinct; and as great changes have taken place in the geological formations of that continent, and ample time has been given for migrations of animals on a large scale, it will be best to give up the inquiry, and acknowledge that, beyond a *probability*, it cannot be known. It is much to be regretted that we can form but a faint idea of our early birthplace when first we diverged from monkeys. What a deep and lasting interest would have attached to the place, could we but have pointed even to the continent with certainty, and said, "There is the birthplace, the cradle, and the home of man." But, alas! no oracle speaks, and we are left in the dark on this matter, for it is a "scientific" fact that no living species connects man with any ape, baboon, or monkey in any

quarter of the world. With no evidence whatever from living species, let us ask whether geology can supply the missing links. At first view we seem to have some evidence of development, as we mark the successive changes that the surface of the earth has undergone, containing orders and species of animals which are now extinct, and followed by others which, in turn, shared the same fate. From this it appeared not unreasonable to conclude that there had been "progressive development" of animals from each other. But in examining minutely the fossils we find there is no imperfection in their organisation, and no links to connect the various species of even the lowest animals. We are, therefore, not surprised to find Mr. Darwin candidly acknowledging that "the great break in the organic chain, between man and his nearest allies, cannot be bridged over by any extinct or living species." It is evident, therefore, that it would be useless to attempt further to inquire *where* man first severed the tie that bound him to an "old world monkey."

Respecting *how* man became developed from "a hairy animal with a tail and pointed ears," Mr. Darwin accounts for this vast change mainly by *sexual* selection, whilst Mr. Wallace, the co-originator of the theory, thinks that it was owing chiefly to *natural* selection. The greater portion of Mr. Darwin's book is occupied with the courtship of the lower animals, and is highly interesting in itself, but has little bearing on the great ques-

tion at issue. Sexual selection appears to us totally inadequate to account for the great diversities in animal life. Mr. Wallace points out a variety of instances in which this kind of selection, if it had any influence at all, would have produced the very opposite effect. For instance, in reference to colour, Mr. Wallace asks, "How are we to believe that the action of an ever-varying fancy for any slight change of colour could produce and fix the definite colours and markings which actually characterise species. Successive generations of female birds, choosing any little variety of colour that occurred among their suitors, would necessarily lead to a speckled or pie-bald and unstable result, not to the beautifully definite colours and markings we see." Still further, Mr. Wallace attributes many of these variations to natural selection, which would "render sexual selection of colour as unnecessary as it is unsupported by evidence." In short, Mr. Wallace believes that Mr. Darwin "imputes far too much to its operation." And when the principle of sexual selection is applied to man to account for the great varieties of the human race, the arguments seem to rest upon a very insecure foundation.

Mr. Darwin thinks that "the inferiority of women," in bodily strength, in courage, and in perseverance, may be traced to the "law of battle for wives," which still prevails among savages. The struggling and fighting for the most beautiful wives gave the men the bodily strength and mental

superiority they now possess. From such an opinion we heartily dissent, and question the "inferiority" so much spoken of, believing fully in the old doctrine that—

> "For contemplation he, and valour formed;
> For softness she, and sweet attractive grace."

Considerable space is denoted to prove that savages think much of their personal appearance, and that the selection of husbands and wives had great influence in producing the differences of mankind. But among savages the men ornament themselves as much as the women, and, in some tribes, the men are more proud of their personal appearance than the women. From the evidence given, it appears that the men "admire the peculiar features of their own race, and detest any wide departure from it." The effect of this would be to preserve the race true, and certainly not to favour the production of new races or species. The absence of hair on the human body cannot be accounted for on the principle of *natural* selection, because the loss of it is not considered a beneficial variation. But *sexual* selection will account for it in the fact that our earliest female ancestors "selected" for husbands those who had least hair, and so, after a "long period," man became hairless. The example of monkeys and apes is adduced, many of which have bare skin on their faces; and still more reliance is placed upon the New Zealand proverb, "There is no woman for a

hairy man." It is not surprising that a smooth-skinned race, like the New Zealanders, should prefer smooth-skinned partners; and, for the same reason, we should expect to find hairy animals associating with those most like themselves, and not seeking bald animals for husbands. Mr. Darwin's argument amounts to this, that if all the young ladies in creation were to seek out husbands with bald-heads, after a very, very long period, the human race would be bald-headed—a "development" we hope never to witness. Nor can we put any faith either in the theory of natural or sexual selection to account for the loss of hair on the human body. On the other hand, we think that a good coat of glossy hair would have been highly useful and even ornamental, not only to our rude and savage ancestors, who lived "before the dawn of history," but to the men and women of modern times, when clothing is scarce and dear, and the winters cold and severe. We may well ask, then, for what purpose of utility or beauty did our ancestors get rid of their hairy coats? Again, the argument from analogy is totally opposed to Mr. Darwin's theory, for the animals inhabiting the warmest climates still retain their hair, and in the colder climates, he admits that it would not add to their comfort, and consequently to their chance of survival in the struggle for existence. The other points of physical "development" are equally involved in doubt and mystery. How man became erect, and from being quadrumanous was turned

into a biped, is an unsolved problem. Still more so, how he came to lose that useful and ornamental appendage commonly called a tail. We can hardly suppose that this loss occurred in the same way as Mr. Darwin accounts for the loss of "pointed ears" in man, and the "power of erecting them," which occurred through the habit of not exercising them. In our own day, tails would have proved a source of great pleasure and amusement to the juvenile part of mankind; especially with tails as well developed as those of the spider monkey. Boys might have climbed the loftiest trees with perfect security against falling. Athletic games on the trapeze and the high rope would have been safe and legitimate. Skating excursions would hardly have been deemed dangerous with a good prehensile organ. How many noble lives would have been saved whose courage and daring led them to scale the highest peaks of the Alps. By the use of a well developed tail these accidents might wholly have been prevented. From these considerations we cannot account for its loss through natural selection, or any other selection. It is simply "inexplicable." But granting the truth of Mr. Darwin's theory of development, and assuming these vast changes in the physical structure and mental powers of man to have taken place at some time, however distant, we are tempted to ask, *When* did these transformations take place? So far back in these "pre-historic times," that the strongest imagination can hardly realise the extent of time

required to effect the changes. All we know is, that it was certainly "before the dawn of history;" and any attempt to calculate the time, even by hundreds of millions of years, is like "the vain endeavour to grapple with the idea of eternity." Such a thorough avoidance of anything like a *date* for man's development, strongly reminds us of the famous story which Corporal Trim endeavoured to recite to Uncle Toby. "There was a certain King of Bohemia," said Trim, "but in whose reign except *his own*, I am not able to inform your Honour." Toby, however, was very obliging, and wanted to help him out of his difficulty, "'Leave out the date entirely, Trim,' said my Uncle Toby." In very similar language, Mr. Darwin says, "There was a certain monkey—" Of this he seems quite sure, and often reminds us of it. "There was a certain monkey, but in what period or country, save his own, I am not able to say."

As we are left therefore to imaginary periods and unlimited ages, we are compelled to give up the inquiry as to the date or probable period when man emerged from mere animalism into manhood. And if the last step of man's evolution be so difficult to demonstrate—if the mere change of a monkey into a man be so beset with unexplainable difficulties, what shall we say of his descent from a fish?

In reference to the colour of the skin in the various races of mankind, Mr. Darwin remarks,

"that the best kind of evidence that the colour of the skin has been modified through sexual selection is *wanting* in the case of mankind," and then remarks, that "it seems at first sight a monstrous supposition that the jet blackness of the negro has been gained through sexual selection; but this view is supported by various analogies, and we know that negroes admire their own blackness." Mr. Darwin concludes by stating that it is his opinion that the various tints of the skin were acquired by sexual selection, "subsequently to the removal of the hair, which, as before stated, must have occurred at a very early period." Respecting the colour of the skin, we have but one remark to make—that to suppose all the varieties of colour originated through sexual selection is "a monstrous supposition," and is unsupported by what Mr. Darwin himself calls "the best kind of evidence." In fact, we have no more faith in this solution of the difficulty than we have in the theory held by the black races themselves respecting the origin of the white race. They believe that originally *all men* were jet black, and that one of their race having committed a dreadful crime, was found out, and being overwhelmed with shame he *turned pale*, and never regained his jet black colour, but transmitted his paleness to all his descendants. Hence the white race.

Again, assuming that Mr. Darwin's theory is true, we might reasonably expect that, at least in some instances, evidence would be forthcoming to

give it an air of plausibility. And though geology bears no record in its fossils of the existence, during thousands of past centuries, of any connecting links in the extinct species, we might have hoped to find some slight support for this theory during the history of the last four thousand years. The testimony of Sir John Lubbock on this point is remarkable.* He says: "It must be admitted that the principal varieties of mankind are of great antiquity. We find on the earliest Egyptian monuments, some of which are certainly as ancient as 2,400 B.C., two great distinct types, the Arab on the east and west of Egypt, the Negro on the south, and the Egyptian type occupying a middle place between the two. The representations of the monuments, although conventional, are so extremely characteristic that it is quite impossible to mistake them. These distinct types still predominate in Egypt and the neighbouring countries." "Thus, then," says Sir John, quoting Mr. Poole, "in this immense interval, we do not find the least change in the Negro or the Arab; and even the type which seems to be intermediate between them, is virtually as unaltered. Those who consider that length of time can change a type of man, will do well to consider the fact that three thousand years give no ratio on which a calculation could be founded."

Thus, after the lapse of three or four thousand years, man remains as distinctly man as he was

* *Pre-historic Times*, 2nd Edit., page 575.

before, and in the same manner we find that animals preserve exactly the same characteristics they had forty centuries ago. The animals we read of in Æsop's Fables, and those worshipped in Egypt, are precisely like what we meet at the present day; and had there been that change going on which Mr. Darwin advocates, we might reasonably have expected to have found some recorded instances of mutation of species even in the space of four thousand years. We go a step further than this, for we doubt very much whether the faculties of man have in the least degree improved during the last six thousand years. Of course we do not refer to the influence of the spread of education and the diffusion of knowledge, which have greatly aided in the development of the intellectual powers *generally*, but the influence on the individual has actually been to weaken his natural vigour of body and mind, and therefore the teaching of history is totally opposed to the "development" theory. Individual men in ancient times advanced to the highest perfection ever attained by the human race. Where can we find poetry to surpass in grandeur and sublimity that of Homer, or religious sentiment more deep and sublime than that found in the Book of Genesis and the Psalms of David. No art is more perfect than that of the Greeks; and no specimens of the human form, seen at this day, are more beautiful than the models which the sculptors of Greece have preserved for us. And

none in modern times have surpassed the matchless oratory of Demosthenes. The evidence, therefore, from history would support a theory the very reverse of Mr. Darwin's. And of gradual development, we can find neither proof nor plausibility from the study of history.

Sir John Herschel,* in discussing the "Formatian and Verification of Theories," lays down the absolute rule that a sound theory should "truly represent *all* the facts and include *all* the laws, to which observation and induction lead."

In testing Mr. Darwin's theory of "evolution" by this canon, we not only fail in finding conclusive proofs in its favour, but we know not absolutely where to begin—where to find either fact, argument, or analogy, which would lead us to place reliance on this vast and astounding theory of the *Descent of Man*. Indeed, this feeling of insufficiency of proof is evident throughout the whole book, as may be seen in such phrases as the following. When Mr. Darwin should have arrived at a positive conclusion, he merely says, "finally, it may not be a *logical conclusion*, but to my *imagination* it is far more satisfactory," &c. In the same doubtful language he speaks of the geographical distribution of animals, and goes so far as to say that "we are often wholly unable even to *conjecture* how this could have been effected." Again, Mr. Darwin remarks, that he has "thus far been baffled in all his attempts to account for the

* *Discourse on the Study of Natural History*, page 204.

differences between the races of man," but hopes to account for some of the differences through sexual selection. With such expressions we have no word of complaint, but we do regret the use of such language as this: that "He who is not content to look, like a savage, at the phenomena of nature as disconnected, cannot any longer believe that man is the work of a separate act of creation," though, at the same time, Mr. Darwin is well aware, as he himself states,* that "the most eminent palæontologists—namely, Cuvier, Agassiz, Barraude, Pictet, Falconer, E. Forbes, &c., and all our greatest geologists, as Lyell, Murchison, Sedgwick, &c.—have unanimously, often vehemently, maintained the immutability of species." Thus some of the greatest names in science are opposed to the very groundwork on which Mr. Darwin builds his theory of development.

Having in the earlier part of this book examined in detail the arguments on the physical analogies between man and the lower animals, and found them wanting, it would be needless here to recapitulate them; and in reference to the mental faculties of man and the brute creation, in which Mr. Darwin attempts to explain away the "enormous" difference, his failure is utter and complete. No less so is his effort to evolve "conscience" out of the social instincts of animals, or to find the belief in God and acts of religious worship in the love of a dog for its master. On Mr. Darwin's

* *Origin of Species*, 3rd Edit., page 336.

theory, the origin of language is absolutely inexplicable, unless with him we can believe that "imitating the growl of a wild beast" was the first step by which man acquired the use of language. With all those vast difficulties unexplained, how can we accept such a theory? Surely some greater power than selection would be required to change a hairy, speechless animal, with four hands, a tail, and pointed ears, into a smooth-skinned, erect, large-brained, fire-using, tool-making animal, endowed with speech and reason. Although infinite ages be allowed for the process of development, we have no grounds for believing that it would ever take place, for we are not aware of any innate tendency, either in man or animals, towards continued development in body and mind. Before the appearance of Mr. Darwin's book on *The Origin of Species*, we looked complacently on the old doctrines of epicurean philosophy, which taught that the "fortuitous concurrence of atoms" was the cause of all organised beings. And when Lamarck, the French naturalist, presented the same theory in a modified form to the world, there were but few scientific men who looked upon it other than as a fanciful mode of explaining real difficulties. But now that this old theory has come forth in a new English dress, with all the attractions that Mr. Darwin has been able to throw around it, will doubtless gain for it many more adherents than it has hitherto had. And it is mainly to the fact that this theory has been intro-

duced by a man of such high scientific attainments and eminent genius as Charles Darwin, that it has received such wide consideration and attention. Nevertheless, after most carefully weighing the evidence adduced, and putting aside all fancies and feelings, we have arrived at the inevitable conclusion that, with all his faults and failings,—Man still bears in his bodily frame and mental power the indelible stamp of his lofty origin.

"Our little systems have their day;
They have their day, and cease to be,
They are but broken lights of Thee;
And Thou, O Lord, art more than they.

"We have but faith, we cannot know,
For knowledge is of things we see.

* * * * * .

"Let knowledge grow from more to more,
But more of reverence in us dwell,
That mind and soul according well,
May make one music as before,

"But vaster." TENNYSON.

THE END.

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AT THE DEATHBED of DARWINISM

A SERIES OF PAPERS

By E. DENNERT, Ph. D.

Authorized Translation

By E. V. O'HARRA and JOHN H. PESCHGES



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CONTENTS

PREFACE 9

INTRODUCTION 27

CHAPTER I.—The Return to Wigand—The Botanist, Julius von Sachs—The Vienna Zoologist, Dr. Schneider 35

CHAPTER II.—Professor Goethe on "The Present Status of Darwinism"—Explains the Reluctance of certain men of Science to Discard Darwinism.. 41

CHAPTER III.—Professor Korchinsky Rejects Darwinism—His Theory of Heterogenesis—Professor Haberlandt of Graz—Demonstration of a "Vital Force"—Its Nature—The Sudden Origination of a New Organ—Importance of the Experiment. 49

CHAPTER IV.—Testimony of a Palaeontologist, Professor Steinmann—On Haeckel's Family Trees—The Principle of Multiple Origin—Extinction of the Saurians—"Darwinism Not the Alpha and Omega of the Doctrine of Descent"—Steinmann's Conclusions 60

CHAPTER V.—Eimer's Theory of Organic Growth—Definite Lines of Development—Rejects Darwin's Theory of Fluctuating Variations—Opposes Weismann—Repudiates Darwinian "Mimicry"—Discards the "Romantic" Hypothesis of Sexual Selection—"Transmutation is a Physiological Process, a Phyletic Growth"..... 69

CHAPTER VI.—Admissions of a Darwinian—Professor von Wagner's Explanation of the Decay of Darwinism—Darwinism Rejects the Inductive Method, Hence Unscientific—Wagner's Contradictory Assertions..... 90

CHAPTER VII.—Haeckel's Latest Production—His Extreme Modesty—Reception of the Weltraetsel—Schmidt's Apologia—The Romanes Incident—Men of Science Who Convicted Haeckel of Deliberate Fraud..... 104

CHAPTER VIII.—Grottewitz Writes on "Darwinian Myths"—Darwinism Incapable of Scientific Proof—"The Principle of Gradual Development Certainly Untenable"—"Darwin's Theory of "Chance" a Myth" 118

CHAPTER IX.—Professor Fleischmann of Erlangen—Doctrine of Descent Not Substantiated—Missing Links—"Collapse of Haeckel's Theory"—Descent Hypothesis "Antiquated"—Fleischmann Formerly a Darwinian—Haeckel's Disreputable Methods of Defense..... 124

CHAPTER X.—Hertwig, the Berlin Anatomist, Protests Against the Materialistic View of Life"—No Empiric Proof of Darwinism—"The Impotence of Natural Selection"—Rejects Haeckel's "Biogenetic Law" 137

CONCLUSION.—Darwinism Abandoned by Men of Science—Supplanted by a Theory in Harmony With Theistic Principles..... 146

PREFACE.

The general tendency of recent scientific literature dealing with the problem of organic evolution may fairly be characterized as distinctly and prevailingly unfavorable to the Darwinian theory of Natural Selection. In the series of chapters herewith offered for the first time to English readers, Dr. Dennert has brought together testimonies which leave no room for doubt about the decadence of the Darwinian theory in the highest scientific circles in Germany. And outside of Germany the same sentiment is shared generally by the leaders of scientific thought. That the popularizers of evolutionary conceptions have any anti-Darwinian tendencies cannot, of course, be for a moment maintained. For who would undertake to popularize what is not novel or striking? But a study of the best scientific literature reveals the fact that the attitude assumed by one of our foremost American zoologists, Professor Thomas Hunt Morgan, in his recent work on "Evolution and Adaptation," is far more general among the leading men of science than is popularly supposed. Professor Morgan's position may be stated thus: He adheres to the general theory of Descent, i.e., he believes the simplest explanation which has yet

been offered of the structural *similarities* between species within the same group, is the hypothesis of a common descent from a parent species. But he emphatically rejects the notion—and this is the quintessence of Darwinism—that the *dissimilarities* between species have been brought about by the purely mechanical agency of natural selection.

To find out what, precisely, Darwin meant by the term "natural selection" let us turn for a moment, to his great work, *The Origin of Species by Means of Natural Selection.* In the second chapter of that work, Darwin observes that small "fortuitous" variations in individual organisms, though of small interest to the systematist, are of the "highest importance" for his theory, since these minute variations often confer on the possessor of them, some advantage over his fellows in the quest for the necessaries of life. Thus these chance individual variations become the "first steps" towards slight varieties, which, in turn, lead to sub-species, and, finally, to species. Varieties, in fact, are "incipient species." Hence, small "fortuitous" fluctuating, individual variations—i. e., those which chance to occur without predetermined direction—are the "first-steps" in the origin of species. This is the first element in the Darwinian theory.

In the third chapter of the same work we read: "It has been seen in the last chapter that amongst organic beings in a state of nature there is some individual variability. * * * But the mere existence of individual variability and of some few well-marked varieties, though necessary as a *foundation* of the work, helps us but little in understanding

how species arise in nature. How have all those exquisite adaptations of one part of the organization to another part, and to the conditions of life, and of one organic being to another being, been perfected? * * * Again it may be asked, how is it that varieties, which I have called incipient species, become ultimately converted into good and distinct species, which in most cases obviously differ from each other far more than do the varieties of the same species? How do those groups of species which constitute what are called distinct genera arise? All of these results follow from the *struggle for life*. Owing to this struggle, variations, however slight and from whatever cause proceeding, if they be in any degree profitable to the individuals of a species, in their infinitely complex relations to other organic beings, and to their physical conditions of life, will tend to the preservation of such individuals and will generally be inherited by the offspring. The offspring also will thus have a better chance of surviving, for of the many individuals of any species which are periodically born, but a small number can survive. I have called this principle by which each slight variation, if useful, is preserved, by the term, "natural selection." Mr. Darwin adds that his meaning would be more accurately expressed by a phrase of Mr. Spencer's coinage, "Survival of the Fittest."

It may be observed that neither "natural selection" nor "survival of the fittest" gives very accurate expression to the idea which Darwin seems to wish to convey. Natural selection is at best a metaphorical description of a

process, and "survival of the fittest" describes the result of that process. Nor shall we find the moving principle of evolution in individual variability unless we choose to regard chance as an efficient agency. Consequently, the only efficient principle conceivably connected with the process is the "struggle for existence;" and even this has only a purely negative function in the origination of species or of adaptations. For, the "surviving fittest" owe nothing more to the struggle for existence than our pensioned veterans owe to the death-dealing bullets which did *not* hit them. Mr. Darwin has, however, obviated all difficulty regarding precision of terms by the remark that he intended to use his most important term, "struggle for existence" in "a large and metaphorical sense."

We have now seen the second element of Darwinism, namely, the "struggle for life." The theory of natural selection, then, postulates the accumulation of minute "fortuitions" individual modifications, which are useful to the possessor of them, by means of a struggle for life of such a sanguinary nature and of such enormous proportions as to result in the destruction of the overwhelming majority of adult individuals. These are the correlative factors in the process of natural selection.

In view of the popular identification of Darwinism with the doctrine of evolution, on the one hand, and with the theory of struggle for life, on the other hand, it is necessary to insist on the Darwinian conception of small, fluctuating, useful variations as the "first-steps" in the evolutionary process. For, this conception distinguishes

Darwinism from the more recent evolutionary theory, e. g., of De Vries who rejects the notion that species have originated by the accumulation of fluctuating variations; and it is quite as essential to the Darwinian theory of natural selection as is the "struggle for life." It is, in fact, an integral element in the selection theory.

The attitude of science towards Darwinism may, therefore, be conveniently summarized in its answer to the following questions: 1. Is there any evidence that such a struggle for life among mature forms, as Darwin postulates, actually occurs?

2. Can the origin of adaptive structures be explained on the ground of their *utility* in this struggle, i. e., is it certain or even probable that the organism would have perished, had it lacked the particular adaptation in its present degree of perfection? On the contrary, is there not convincing proof that many, and presumably most, adaptations cannot be thus accounted for?

The above questions are concerned with "the struggle for life." Those which follow have to do with the problem of variations.

3. Is there any reason to believe that new species may originate by the accumulation of fluctuating individual variations?

4. Does the evidence of the geological record—which, as Huxley observed, is the only direct evidence that can be had in the question of evolution—does this evidence tell for or against the origin of existing species from earlier ones by means of minute gradual modifications?

We must be content here with the briefest outline of the reply of science to these inquiries.

1. Darwin invites his readers to "keep steadily in mind that each organic being is striving to increase in geometrical ratio." If this tendency were to continue unchecked, the progeny of living beings would soon be unable to find standing room. Indeed, the very bacteria would quickly convert every vestige of organic matter on earth into their own substance. For has not Cohn estimated that the offspring of a single bacterium, at its ordinary rate of increase under favorable conditions, would in three days amount to 4,772 billions of individuals with an aggregate weight of seven thousand five hundred tons? And the 19,000,000 elephants which, according to Darwin, should to-day perpetuate the lives of each pair that mated in the twelfth century—surely these would be a "magna pars" in the sanguinary contest. When the imagination views these and similar figures, and places in contrast to this multitude of living beings, the limited supply of nourishment, the comparison of nature with a huge slaughter-house seems tame enough. But reason, not imagination, as Darwin observes more than once, should be our guide in a scientific inquiry.

It is observed on careful reflection that Darwin's theory is endangered by an extremely large disturbing element, viz., accidental destruction. Under this term we include all the destruction of life which occurs in utter indifference to the presence or absence of any individual variations from the parent form. Indeed, the greatest destruc-

tion takes place among immature forms before any variation from the parent stock is discernible at all. In this connection we may instance the vast amount of eggs and seeds destroyed annually irrespective of any adaptive advantage that would be possessed by the matured form. And the countless forms in every stage of individual development which meet destruction through "accidental causes which would not be in the least degree mitigated by certain changes of structure or of constitution which would otherwise be beneficial to the species." This difficulty, Darwin himself recognized. But he was of opinion that if even "one-hundredth or one-thousandth part" of organic beings escaped this fortuitous destruction, there would supervene among the survivors a struggle for life sufficiently destructive to satisfy his theory. This suggestion, however, fails to meet the difficulty. For, as Professor Morgan points out, Darwin assumes "that a second competition takes place after the first destruction of individuals has occurred, and this presupposes that more individuals reach maturity than there is room for in the economy of nature." It presupposes that the vast majority of forms that survive accidental destruction, succumb in the second struggle for life in which the determining factor is some slight individual variation, e. g., a little longer neck in the case of the giraffe, or a wing shorter than usual in the case of an insect on an island. The whole theory of struggle, as formulated by Darwin, is, therefore, a violent assumption. Men of science now recognize that "egoism and struggle play a very subordinate part in organic devel-

opment, in comparison with co-operation and social action." What, indeed, but a surrender of the paramountcy of struggle for life, is Huxley's celebrated Romanes lecture in which he supplants the cosmic process by the ethical? The French free-thinker, Charles Robin, gave expression to the verdict of exact science when he declared: "Darwinism is a fiction, a poetical accumulation of probabilities without proof, and of attractive explanations without demonstration."

2. The hopeless inadequacy of the struggle for life to account for adaptive structures has been dealt with at considerable length by Professor Morgan in the concluding chapters of the work already mentioned. We cannot here follow him in his study of the various kinds of adaptations, e. g., form and symmetry, mutual adaptation of colonial forms, protective coloration, organs of extreme perfection, tropisms and instincts, etc., in regard to the origin of each of which he is forced to abandon the Darwinian theory. It will suffice to call attention to his conclusions concerning the phenomena of regeneration of organs. By his research in this special field Professor Morgan has won international recognition among men of science. It was while prosecuting his studies in this field that he became impressed with the utter bankruptcy of the theory of natural selection which Darwinians put forward to explain the acquisition by organisms of this most useful power of regeneration. "It is not difficult to show that regeneration could not in many cases, and presumably in none, have been acquired through natural selection (p. 379). If an earth worm

(*allolobophora foetida*) be cut in two in the middle, the posterior piece regenerates at its anterior cut end, not a head but a tail. "Not by the widest stretch of the imagination can such a result be accounted for on the selection theory." Quite the reverse case presents itself in certain planarians. If the head of *planaria lugubris* is cut off just behind the eyes, there develops at the cut surface of the head-piece another head turned in the opposite direction. "These and other reasons," concludes Professor Morgan (p. 381), "indicate with certainty that regeneration cannot be explained by the theory of natural selection."

The ingenuity of the Darwinian imagination, however, will hardly fail to assign some reason why two heads are more useful than one in the above instance, and thus reconcile the phenomenon with Darwinism. For, according to Professor Morgan "to imagine that a particular organ is useful to its possessor and to account for its origin because of the imagined benefit conferred, is the general procedure of the followers of the Darwinian school." "Personal conviction, mere possibility," writes Quatrefages, "are offered as proofs, or at least as arguments in favor of the theory." "The realms of fancy are boundless," is Blanchard's significant comment on Darwin's explanation of the blindness of the mole. "On this class of speculation," says Bateson in his "Materials for the Study of Variation," referring to Darwinian speculation as to the beneficial or detrimental nature of variations, "on this class of speculation the only limitations are those of the ingenuity of the author." The general form of Darwin's argument,

declared the writer of a celebrated article in the North British Review, is as follows: "All these things may have been, therefore my theory is possible; and since my theory is a possible one, all those hypotheses which it requires are rendered probable."

3. We pass now to the question of the possibility of building up a new species by the accumulation of chance individual variations. That species ever originate in this way is denied by the advocates of the evolutionary theory which is now superseding Darwinism. Typical of the new school is the botanist Hugo De Vries of Amsterdam. The "first-steps" in the origin of new species according to De Vries are not fluctuating individual variations, but mutations, i. e., definite and permanent modifications. According to the mutation theory a new species arises from the parent species, not gradually but suddenly. It appears suddenly "without visible preparation and without transitional steps." The wide acceptance with which this theory is meeting must be attributed to the fact that men of science no longer believe in the origin of species by the accumulation of slight fluctuating modifications. To quote the words of De Vries, "Fluctuating variation cannot overstep the limits of the species, even after the most prolonged selection—still less can it lead to the production of new, permanent characters." It has been the wont of Darwinians to base their speculations on the assumption that "an inconceivably long time" could effect almost anything in the matter of specific transformations. But the evidence which has been amassed during the past forty yeas leaves

no doubt that there is a limit to individual variability which neither time nor skill avail to remove. As M. Blanchard asserts in his work, *La vie des ctres animes* (p. 102), "All investigation and observation make it clear that, while the variability of creatures in a state of nature displays itself in very different degrees, yet, in its most astonishing manifestations, it remains confined within a circle beyond which it cannot pass."

It is interesting to observe how writers of the Darwinian school attempt to explain the origin of articulate language as a gradual development of animal sounds. "It does not," observes Darwin, "appear altogether incredible that some unusually wise ape-like animal should have thought of imitating the growl of a beast of prey, so as to indicate to his fellow monkeys the nature of the expected danger. And this would have been a first step in the formation of a language." But what a tremendous step! An ape-like animal that "thought" of imitating a beast must certainly have been "unusually wise." In bridging the chasm which rational speech interposes between man and the brute creation, the Darwinian is forced to assume that the whole essential modification is included in the first step. Then he conceals the assumption by parcelling out the accidental modification in a supposed series of transitional stages. He endeavors to veil his inability to explain the first step, as Chevalier Bunsen remarked, by the easy but fruitless assumption of an infinite space of time, destined to explain the gradual development of animals into men; as if millions of years could supply the want of an agent

necessary for the first movement, for the first step in the line of progress. "How can speech, the expression of thought, develop itself in a year or in millions of years, out of unarticulated sounds which express feelings of pleasure, pain, and appetite? The common-sense of mankind will always shrink from such theories."

4. The hopes and fears of Darwinians have rightly been centered on the history of organic development as outlined in the geological record. It has been pointed out repeatedly by the foremost men of science that if the theory of genetic descent with the accumulation of small variations be the true account of the origin of species, a complete record of the ancestry of any existing species would reveal no distinction of species and genera. Between any two well-defined species, if one be derived from the other, there must be countless transition forms. But palaeontology fails to support the theory of evolution by minute variations. Darwinism has been shattered on the geologic rocks. "The complete absence of intermediate forms," says Mr. Carruthers, "and the sudden and contemporaneous appearance of highly organized and widely separated groups, deprive the hypothesis of genetic evolution of any countenance from the plant record of these ancient rocks. The whole evidence is against evolution (i. e., by minute modification) and there is none for it." (cf. *History of Plant Life and its Bearing on Theory of Evolution*, 1898). Similar testimony regarding the animal kingdom is borne by Mr. Mivart in the following carefully worded statement: "The mass of palaeontological evi-

dence is indeed overwhelmingly against minute and gradual modification." "The Darwinian theory," declared Professor Fleischmann of Erlangen, recently, "has not a single fact to confirm it in the realm of nature. It is not the result of scientific research, but purely the product of the imagination."

On one occasion Huxley expressed his conviction that the pedigree of the horse as revealed in the geological record furnished demonstrative evidence for the theory of evolution. The question has been entered into in detail by Professor Fleischmann in his work, *Die Descendenztheorie.* In this book the Erlangen professor makes great capital out of the "trot-horse" (Paradepferd) of Huxley and Haeckel; and as regards the evolutionary theory, easily claims a verdict of "not proven." In this connection the moderate statement of Professor Morgan is noteworthy: "When he (Fleischmann) says there is no absolute proof that the common plan of structure must be the result of blood relationship, he is not bringing a fatal argument against the theory of descent, for no one but an enthusiast sees anything more in the explanation than a very probable theory that appears to account for the facts. To demand an absolute proof is to ask for more than any reasonable advocate of the descent theory claims for it." (Professor Morgan, as we have already seen, rejects Darwinism, and inclines to the mutation theory of De Vries.) The vast majority of Darwinians must, therefore, be classed as enthusiasts" who are not "reasonable advocates of the descent theory." For has not Professor Marsh told his readers

that "to doubt evolution is to doubt science?" And similar assertions have been so frequently made and reiterated by Darwinians that the claim that Darwinism has become a dogma contains, as Professor Morgan notes, more truth than the adherents of that school find pleasant to hear.

More interesting, however, than Huxley's geological pedigree of the horse is Haeckel's geological pedigree of man. One who reads Haeckel's *Natural History of Creation* can hardly escape the impression that the author had actually seen specimens of each of the twenty-one ancestral forms of which his pedigree of man is composed. Such, however, was not the case. Quatrefages, speaking of this wonderful genealogical tree which Haeckel has drawn up with such scientific accuracy of description, observes: "The first thing to remark is that *not one* of the creatures exhibited in this pedigree has ever been seen, either living or in fossil. Their existence is based entirely upon theory." (*Les Emules de Darwin*, ii. *p.* 76). "Man's pedigree as drawn up by Haeckel," says the distinguished savant, Du Bois-Reymond," is worth about as much as is that of Homer's heroes for critical historians."

In constructing his genealogies Haeckel has frequent recourse to his celebrated "Law of Biogenesis." The "Law of Biogenesis" which is the dignified title Haeckel has given to the discredited recapitulation theory, asserts that the embryological development of the individual (ontogeny), is a brief recapitulation, a summing up, of the stages through which the species passed in the course of its evolution in the geologic past, (phylogeny). Ontogeny is a brief reca-

pitulation of phylogeny. This, says Haeckel, is what the "fundamental Law of Biogenesis" teaches us. (The reader of Haeckel and other Darwinians will frequently find laws put forward to establish facts: whereas other men of science prefer to have facts establish laws). When, therefore, as Quatrefages remarks, the transition between the types which Haeckel has incorporated into his genealogical tree, appears too abrupt, he often betakes himself to ontogeny and describes the embryo in the corresponding interval of development. This description he inserts in his genealogical mosaic, by virtue of the "Law of Biogenesis."

Many theories have been constructed to explain the phenomena of embryological development. Of these the simplest and least mystical is that of His in the great classic work on embryology, "Unsere Koerperform." His tells us: "In the entire series of forms which a developing organism runs through, each form is the necessary antecedent step of the following. If the embryo is to reach the complicated end-form, it must pass, step by step, through the simpler ones. Each step of the series is the physiological consequence of the preceding stage, and the necessary condition for the following." But whatever theory be accepted by men of science, it is certainly not that proposed by Haeckel. Carl Vogt after giving Haeckel's statement of the "Law of Biogenesis" wrote: "This law which I long held as well-founded, is absolutely and radically false." Even Oskar Hertwig, perhaps the best known of Haeckel's former pupils, finds it necessary to change Haeckel's expression of the biogenetic law so that "a contradiction con-

tained in it may be removed." Professor Morgan, finally, rejects Haeckel's boasted "Law of Biogenesis" as "*in principle, false.*" And he furthermore seems to imply that Fleischmann merits the reproach of men of science, for wasting his time in confuting "the antiquated and generally exaggerated views of writers like Haeckel."

"Antiquated and generally exaggerated views." Such is the comment of science on Haeckel's boast that Darwin's pre-eminent service to science consisted in pointing out how purposive adaptations may be produced by natural selection without the direction of mind just as easily as they may be produced by artificial selection and human design. And yet the latest and least worthy production from the pen of this Darwinian philosopher, *The Riddle of the Universe*, is being scattered broad-cast by the anti-Christian press, in the name and guise of *popular* science. It is therein that the evil consists. For the discerning reader sees in the book itself, its own best refutation. The pretensions of Haeckel's "consistent and monistic theory of the eternal cosmogenetic process" are best met by pointing to the fact that its most highly accredited and notorious representative has given to the world in exposition and defense of pure Darwinian philosophy, a work, which, for boldness of assertion, meagerness of proof, inconsequence of argument, inconsistency in fundamental principles and disregard for facts which tell against the author's theory, has certainly no equal in contemporary literature. In the apt and expressive phrase of Professor Paulsen, the book "fairly drips with superficial-

ity" (von Seichtigkeit triefen). If the man of science is to be justified, as Huxley suggested, not by faith but by verification, Haeckel and his docile Darwinian disciples have good reason to tremble for their scientific salvation.

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Amen.

INTRODUCTION.

During the last few years I have published under this title short articles dealing with the present status of Darwinism. In view of the kind reception which has been accorded to these articles by the reading public I have thought it well to bring them together in pamphlet form. Indeed, the Darwinian movement and its present status are eminently deserving of consideration, especially on the part of those before whom Darwinism has hitherto always been held up triumphantly as a scientific disproof of the very foundations of the Christian faith.

By way of introduction and explanation some general preliminary remarks may not be amiss here. Previous to twenty or thirty years ago, it was justifiable to identify Darwinism with the doctrine of Descent, for at that time Darwinism was the only doctrine of Descent which could claim any general recognition. Consequently, one who was an adherent of the doctrine of Descent was also a Darwinian. Those to whom this did not apply were so few as to be easily counted. The dispute then hinged primarily on Darwinism; hence, for those who did not admit the truth of that theory, the doctrine of Descent was for the most part also a myth.

I say, for the most part; for there were already even at that time a few clear-sighted naturalists (Wigand, Naegeli, Koelliker and others) who saw plainly the residue of truth that would result from the discussion. But to the overwhelming majority, the alternatives seemed to be: Either Darwinism or no evolution at all. Today, however, the state of things is considerably altered. The doctrine of Descent is clearly and definitely distinguished from Darwinism at least by the majority of naturalists. It is therefore of the utmost importance that this luminous distinction should likewise become recognized in lay circles.

My object in these pages is to show that Darwinism will soon be a thing of the past, a matter of history; that we even now stand at its death-bed, while its friends are solicitous only to secure for it a decent burial.

Out of the chaos of controversy which has obtained during the last four decades there has emerged an element of truth—for there lurks a germ of truth in most errors—which has gained almost universal recognition among contemporary men of science, namely, the doctrine of Descent. The fact that living organisms form an ascending series from the less perfect to the more perfect; the further fact that they also form a series according as they display more or less homology of structure and are formed according to similar types; and, lastly, that the fossil remains of organisms found in the various strata of the earth's surface likewise represent an ascending series from the simple to the more complex—these three facts suggested to naturalists the thought that living organisms were

not always as we find them today, but that the more perfect had developed from simpler forms through a series of modifications. These thoughts were at first advanced with some hesitation, and were confined to narrow circles. They received, however, material support when, during the fourth decade of the 19th century the splendid discovery was made (by K. E. von Baer) that every organism is slowly developed from a germ, and in the process of development passes through temporary lower stages to a permanent higher one. Even at that time many naturalists believed in a corresponding development of the whole series of organisms, without of course being able to form a clear conception of the process. Such was the state of affairs when Darwin in the year 1859 published his principal work, *The Origin of Species by Means of Natural Selection.* In this work for the first time an exhaustive attempt was made to sketch a clear and completely detailed picture of the process of development.

Darwin started with the fact that breeders of animals and growers of plants, having at their disposal a large number of varieties, always diverging somewhat from each other, choose individuals possessing characteristics which they desired to strengthen, and use only these for procreation. In this manner the desired characteristic is gradually made more prominent, and the breeder appears to have obtained a new species. Similar conditions are supposed to prevail in Nature, only that there is lacking the selecting hand of the breeder. Here the so-called principle of Natural Selection holds automatic sway by means of the

Struggle for Existence. All the various forms of life are warring for the means of subsistence, each striving to obtain for itself the best nourishment, etc. In this struggle those organisms will be victorious which possess the most favorable characteristics; all others must succumb. Hence those only will survive which are best adapted to their environment. But between those which survive, the struggle begins anew, and when the favoring peculiarities become more pronounced in some, (by chance, of course) these in turn win out. Thus Nature gradually improves her various breeds through the continued action of a self-regulating mechanism. Such are the main features of Darwinism, its real kernel, about which of course,—and this is a proof of its insufficiency,—from the very beginning a number of auxiliary hypotheses attached themselves.

Darwin's theory sounds so clear and simple, and seems at first blush so luminous that it is no wonder if many careful naturalists regarded it as an incontrovertible truth. The warning voice of the more prudent men of science was silenced by the loud enthusiasm of the younger generation over the solution of the greatest of the world-problems: the genesis of living beings had been brought to light, and—a thing which admitted of no doubt—man as well as the brute creation was a product of purely natural evolution. The doctrine which materialism had already proclaimed with prophetic insight, had at length been irrefragably established on a scientific basis: God, Soul and Immortality were contemptuously relegated to the domain of nursery tales. What further use was there for a God

when, in addition to the Kant-Laplacian theory of the origin of the planetary system, it had been discovered that living organisms had likewise evolved spontaneously? How could man who had sprung from the irrational brute possess a soul? And thus, finally, disappeared the third delusion, the hope of immortality. For with death the functions of the body simply cease, as also do those of the brain, which people had foolishly believed to be something more than an aggregation of atoms. The body dissolves into its constituent elements and serves in its turn to build up other organisms: but as a human body it all turns to dust nor 'leaves a wrack behind'. Thus Darwinism was made the basis first for a materialistic, and then for a monistic, view of the world, and hence came to be rigorously opposed to every form of Theism. But since, at that time, Darwinism was the only theory of evolution recognized by the world of science, the opposition of the Christian world was directed not specifically against Darwinism, but against the theory of evolution as such. The wheat was rooted up with the tares.

I will not discuss here which of the two views concerning creation; the origin of the world in one moment of time, or a gradual evolution of the world and its potentialities, is the more worthy of the creative power of God. Manifestly the greatness and magnificence of creation will in no way be compromised by the concept of evolution. This, of course, is simply my opinion. Any further statement would be out of place here.

But what is the Darwinian position?

It is merely a special form of the evolutionary theory, one of the various attempts to explain how the process of development actually took place. Darwinism as understood in the following chapters possesses the following characteristic traits:

(1) Evolution began and continues without the aid or intervention of a Creator. No such statement was made.

(2) In the production of Variations there is no definite law; Chance reigns supreme.

(3) There is no indication of purpose or finality to be detected anywhere in the evolutionary process.

(4) The working factor in evolution is Egoism, a war of each against his fellows: this is the predominating principle which manifests itself in Nature.

(5) In this struggle the strongest, fleetest and most cunning will always prevail, (the Darwinian term "fittest" has been the innocent source of a great deal of error).

(6) Man, whether you regard his body or his mind, is nothing but a highly developed animal.

A careful examination of Darwinism shows that these are the necessary presuppositions, or, if you will, the inevitable consequences of that theory. To accept that theory is to repudiate the Christian view of the world. The truth of the above propositions is utterly incompatible, not only with any religious views, but with our civil and social principles as well.

The most patent facts of man's moral life, however, cannot be explained on any such hypothesis, and the logic of events has already shown that Darwinism could never have won general acceptance but for the incautious enthusiasm of youth which intoxicated the minds of the rising generation of naturalists and incapacitated them for the exercise of sober judgment. To show that there is among contemporary men of science a healthy reaction against Darwinism is the object of this treatise.

The reader may now ask, What, then, is your idea of evolution? It certainly is easier to criticise than to do constructive work. An honest study of nature, however, inevitably leads us to the conclusion that the final solution of the problem is still far distant. Many a stone has already been quarried for the future edifice of evolution by unwearied research during the last four decades. But in opposition to Darwinism it may, at the present time, be confidently asserted that any future doctrine of evolution will have to be constructed on the following basic principles:

(1) All evolution is characterized by finality; it proceeds according to a definite plan, and tends to a definite end.

(2) Chance and disorder find no place in Nature; every stage of the evolutionary process is the result of law-controlled factors.

(3) Egoism and struggle among living organisms are of very subordinate importance in comparison with co-operation and social action.

(4) The soul of man is an independent substance, and entirely unintelligible as a mere higher stage of development of animal instinct. NO PROOF OF SOUL

A theory of evolution, however, resting on these principles cannot dispense with a Creator and Conserver of the world and of life.

CHAPTER I.

"It was a happy day that people threw off the straight-jacket of logic and the burdensome fetters of strict method, and mounting the light-caparisoned steed of philosophic science, soared into the empyrean, high above the laborious path of ordinary mortals. One may not take offense if even the most sedate citizen, for the sake of a change, occasionally kicks over the traces, provided only that he returns in due time to his wonted course. And now in the domain of Biology, one is led to think that the time has at length arrived for putting an end to mad masquerade pranks and for returning without reserve to serious and sober work, to find satisfaction therein." With these words did the illustrious Wigand, twenty-five years ago, conclude the preface to the third volume of his large classical work against Darwinism. True. he did not at that time believe that the mad campaign of Darwinism had already ended to its own detriment, but he always predicted with the greatest confidence that the struggle would soon terminate in victory for the anti-Darwinian camp. When Wigand closed his eyes in death in 1896, he was able to bear with him the consciousness that the era of Darwinism was approaching its end, and that he had been in the right.

Today, at the dawn of the new century, nothing is more certain than that Darwinism has lost its prestige among men of science. It has seen its day and will soon be reckoned a thing of the past. A few decades hence when people will look back upon the history of the doctrine of Descent, they will confess that the years between 1860 and 1880 were in many respects a time of carnival; and the enthusiasm which at that time took possession of the devotees of natural science will appear to them as the excitement attending some mad revel.

A justification of our hope that Wigand's warning prediction will finally be fulfilled is to be found in the fact that today the younger generation of naturalists is departing more and more from Darwinism. It is a fact worthy of special mention that the opposition to Darwinism today comes chiefly from the ranks of the zoologists, whereas thirty years ago large numbers of zoologists from Jena associated themselves with the Darwinian school, hoping to find there a full and satisfactory solution for the profoundest enigmas of natural science.

The cause of this reaction is not far to seek. There was at the time a whole group of enthusiastic Darwinians among the university professors, Haeckel leading the van, who clung to that theory so tenaciously and were so zealous in propagating it, that for a while it seemed impossible for a young naturalist to be anything but a Darwinian. Then the inevitable reaction gradually set in. Darwin himself died, the Darwinians of the sixties and seventies lost their pristine ardor, and many even went beyond Darwin.

Above all, calm reflection took the place of excited enthusiasm. As a result it has become more and more apparent that the past forty years have brought to light nothing new that is of any value to the cause of Darwinism. This significant fact has aroused doubts as to whether after all Darwinism can really give a satisfactory explanation of the genesis of organic forms.

The rising generation is now discovering what discerning scholars had already recognized and stated a quarter of a century ago. They are also returning to a study of the older opponents of Darwinism, especially of Wigand. It is only now, many years after his death, that a tribute has been paid to this distinguished savant which unfortunately was grudgingly withheld during his life. One day recently there was laid before his monument in the Botanical Garden of Marburg a laurel-wreath with the inscription: "To the great naturalist, philosopher and man." It came from a young zoologist at Vienna who had thoroughly mastered Wigand's great anti-Darwinian work, an intelligent investigator who had set to work in the spirit of Wigand. Another talented zoologist, Hans Driesch, dedicates to the memory of Wigand two books in rapid succession and reprehends the contemporaries of that master of science for ignoring him. O. Hammann abandons Darwinism for an internal principle of development. W. Haacke openly disavows Darwinism; and even at the convention of naturalists in 1897, L. Wilser was allowed to assert without contradiction that, "anyone who has committed himself to Darwinism can no longer be ranked as a naturalist."

These are all signs which clearly indicate a radical revolution, and they are all the more significant since it is the younger generation, which will soon take the lead, that thinks and speaks in this manner. But it is none the less noteworthy that the younger naturalists are not alone in this movement. Many of the older men of science are swelling the current. We shall recall here only the greatest of those whom we might mention in this connection.

Julius von Sachs, the most gifted and brilliant botanist of the last century, who unfortunately is no longer among us, was in the sixties an outspoken Darwinian, as is evident especially from his History of Botany and from the first edition of his Handbook of Botany. Soon, however, Sachs began to incline toward the position assumed by Naegeli; and as early as 1877, Wigand, in the third volume of his great work, expressed the hope that Sachs would withdraw still further from Darwinism. As years went by, Sachs drifted more and more from his earlier position, and Wigand was of opinion that to himself should be ascribed the credit of bringing about the change. During his last years Sachs had become bitterly opposed to Darwinism, and in his masterly "Physiological Notes" he took a firm stand on the "internal factors of evolution."

During recent years I had the pleasure of occasional correspondence with Sachs. On the 16th of September, 1896, he wrote me: For more than twenty years I have recognized that if we are to build up a strictly scientific theory of organic structural processes, we must separate the doctrine of Descent from Darwinism. It was with this

intention that he worked during the last years of his life and it is to be hoped that his school will continue his researches with this aim in view.

The tendency among naturalists to return to Wigand is well exemplified in an article contributed to the "Preussischen Jahrbuecher" for January, 1897, by Dr. Karl Camillo Schneider, assistant at the zoological Institute of the University of Vienna. This article which is entitled The Origin of Species, pursues Wigand's train of thought throughout, and whole sentences and even paragraphs are taken verbatim from his main work. This, at all events, is a very instructive indication of the present tendency which deserves prominence: and its significance becomes more evident when we recall how the work of Wigand was received by the non-christian press a quarter of a century ago. It was either ridiculed or ignored. The two methods of treatment were applied to his writings which are always readily employed when the critic has nothing pertinent to say. It is interesting to note that Darwin himself employed this method. Wigand once told me that he had sent Darwin a copy of his work and had addressed a letter to him at the same time merely stating that he had sent the book, making no reference to the line of thought contained in it. Darwin answered immediately in the kindest manner that he had not as yet received the book, but when it arrived he would at once make a careful study of its contents. Darwin did not write to him again, and when a new edition of his works appeared, the work of Wigand, the most comprehensive answer to Darwin ever written, was passed over

without even a passing mention. Thus Darwin completely ignored his keenest antagonist.

As has been said, the majority of those who wrote about Wigand ridiculed him: very few regarded him seriously, and even these indulged chiefly in personal recriminations. Thus matters stood twenty-five years ago. Wigand's prediction passed unheeded. That a periodical not having a specifically Christian circle of readers should now publish a condemnation of Darwinism entirely in accordance with the views of Wigand, is a fact which indicates a notable change of sentiment during the intervening years. I should not be at all astonished if many who sneered at Wigand twenty years ago, now read the article in the Preussischen Jahrbuecher with entire approval. Ill-will towards Wigand has not altogether disappeared even today. This is evident from the fact that as yet Dr. Schneider does not venture to defend Wigand publicly, nor to acknowledge him as his principal authority. We must be content, however, if only, the truth will finally prevail.

CHAPTER II.

Striking testimony relative to the present position of Darwinism is borne by the Strasburg zoologist, Dr. Goette, who has won fame by his invaluable labors as an historian of evolutionary theory. In the "Umschau," No. 5, 1898, he discusses the "Present Status of Darwinism," and the conclusions he arrives at, are identical with mine. At the outset Goette indicates the distinction between Darwinism and the doctrine of Descent, and then points out that the distinguishing features of the former consist not so much in the three facts of Heredity, Variation, and Over-production, but rather in Selection, Survival of the Fittest, and also in that mystical theory of heredity—the doctrine of Pangenesis—which is peculiarly Darwinian. Since this theory of Pangenesis has found no adherents, the question may henceforth be restricted to the doctrine of natural selection. This Goette very well observes.

He points, moreover, to the fact that the misgivings that were entertained concerning the doctrine of natural selection on its first appearance, were, on the whole, precisely the same as they are to-day; only with this difference, that formerly they were disregarded by naturalists whose clearness of vision was obscured by excessive enthusiasm; whereas, today men have again returned to their sober senses and lend their attention more readily to objections.

Goette recalls the fact that M. Wagner tried to supplement natural selection with his "Law of Migration," and that later on, Romanes and Gulick endeavored to supply the evident deficiencies in Darwin's theory, by invoking other principles; and that even at that time, Askenasy, Braun, and Naegeli—and more recently, the lately deceased Eimer—insisted on the fact of definitely ordered variations, in opposition to the theory of Selection.

Many naturalists recognize the difficulties but do not abandon the theory of Selection, thinking that some supplementary principle would suffice to make it acceptable: many others refuse to decide either for or against Darwinism and maintain towards it an attitude of indifference. The younger investigators, however, are utterly opposed to it. "There can be no doubt that since its first appearance the influence of Darwinism on men's minds has notably diminished, although the theory has not been entirely discarded."—But the very fact that the younger naturalists are hostile to it, makes it evident that Darwinism has a still darker future in store for it: that sooner or later it will come to possess a merely historical interest.

"The present position of Darwinism," says Goette, "is characterized especially by the uncertainty of criticism which is unable to declare definitely in favor of either side." Goette finds the chief cause of this uncertainty in the fact "that men of science (even Darwin himself) have widened the concept of selection as a means of originating new species through the interaction of individuals in the same species, so as to express the mutually antagonistic relations

existing between several such species." The latter alone is subject to experimental verification, but it can only cause the isolation of existing forms and is not a species-originating selection—with which alone we are here concerned. This kind of selection can enfeeble the existing flora and fauna, but cannot produce a new species. Selection productive of new species "is not actually demonstrable; it is a purely theoretical invention."

Goette next points out that the investigator is everywhere confronted by definitely-directed variation: a fact which does not harmonize with the theory of selection, nor, consequently with Darwinism. If some scientists have not as yet accepted Eimer's presentation of this doctrine, their action is most probably to be attributed to the fear lest "they should have to accept not merely, variation according to definite laws, but likewise a principle of finality and other causes lying beyond the range of scientific investigation." The rejection of the theory of selection often promotes, as Goette rightly observes, a reactionary tendency towards *a priori* explanations of phenomena with which we are but slightly acquainted. "There are naturalists who do not discard the theory of selection simply because it seems to furnish a much-desired mechanical explanation of purposive adaptions" (a momentous admission to which we shall have occasion to revert).

Others have broken entirely with selection and the principle of utility and extend the idea of finality to the general capacity of organisms to persist. Thus adaptation becomes a principle which transcends the limits of natural

science and pervades the whole domain of life. Goette observes that Darwin spoke of useful, less useful and indifferent organisms, by which he meant those adaptations destined for particular vital functions which tend to make the organs more and more specialized. Since the ability to live is threatened by this specialization it cannot be purposive. This is not wholly true, because the more specialized the individual organ becomes, the more perfect is the whole organism which is composed of these specialized organs. The functions of the individual organ may be restricted, but the power of the entire organism is notably increased, according to the law of the division of labor. Goette therefore has not sufficient grounds for rejecting this expression. He considers that a real and permanent purpose for the individual living forms is out of the question, but that this purpose may be sought for in the development and history of the collective life of nature. Definitely ordered variation, he thinks, a scientific explanation of which is indeed yet forthcoming, will explain adaptation equally as well as does selection. After what has been said this statement of Goette must come as a surprise, for one would think that according to his view definite variation explains adaptations better than selection. Goette sums up his main conclusion in the following words: "The doctrine of Heredity or of Descent, which comes from Lamarck though it was first made widely known by Darwin, has since continually gained a broader and surer foundation. But Darwin's own doctrine re-

garding the causes and process of Descent which alone can be called Darwinism, has on the other hand doubtlessly waned in influence and prestige."

This is exactly what we also maintain: The establishment of the theory of Descent in general, and the continual retrogression of Darwinism in particular. Wigand was entirely right when he said that Darwinism would not live beyond the century.

We may, however, derive from the discussions of Goette something else that is of the highest importance, namely, an admission in which is to be found the real and fundamental explanation of the conduct of the majority of naturalists who still cling to Darwinism. It does not consist in the fact that they are convinced of the truth of Darwinism but in their "reluctance to give up the mechanical explanation of finality proposed by Darwin," or rather in the fear of being driven to the recognition of theistic principles. With commendable candor Goette attacks this method of keeping up a system notwithstanding its recognized deficiencies. Goette furthermore points out especially that this recognition is more widespread than one might be able to gather from occasional discussions on the subject.

From the account which Goette gives of the present status of Darwinism we may safely conclude that Darwinism had entered upon a period of decay; it is in the third stage of a development through which many a scientific doctrine has already passed.

The four stages of this development are the following:

1. The incipient stage: A new doctrine arises, the older representatives of the science oppose it partly because of keener insight and greater experience, partly also from indolence, not wishing to allow themselves to be drawn out of their accustomed equilibrium; among the younger generation there arises a growing sentiment in favor of the new doctrine.

2. The stage of growth: the new doctrine continually gains greater favor among the young generation, finding vent in bursts of enthusiasm; some of the cautious seniors have passed away, others are carried along by the stream of youthful enthusiasm in spite of better knowledge, and the voices of the thoughtful are no longer heard in the general uproar, exultingly proclaiming that to live is bliss.

3. The period of decay: the joyous enthusiasm has vanished; depression succeeds intoxication. Now that the young men have themselves grown older and become more sober, many things appear in a different light. The doubts already expressed by the old and prudent during the stage of growth are now better appreciated and gradually increase in weight. Many become indifferent, the present younger generation becomes perplexed and discards the theory entirely.

4. The final stage: the last adherents of the "new doctrine" are dead or at least old and have ceased to be influential, they sit upon the ruins of a grandeur that even now belongs to the "good old time." The influential and directing spirits have abandoned this doctrine, once so important and seemingly invincible, for the consideration of

living issues and the younger generation regards it as an interesting episode in the history of science.

With reference to Darwinism we are in the third stage which is characterized especially by the indifference of the present middle-aged generation and by growing opposition on the part of the younger coming generation. This very characteristic feature is brought into prominence by the discussion of Goette. If all signs, however, are not deceptive, this third stage, that of decay, is drawing to an end; soon we shall enter the final stage and with that the tragic-comedy of Darwinism will be brought to a close.

If some one were to ask me how according to the count of years, I should determine the extent of the individual stages of Darwinism, this would be my answer:

1. The incipient stage extends from 1859 (the year during which Darwin's principal work, *The Origin of Species*, appeared) to the end of the sixties.

2. The stage of growth: from that time, for about 20 years, to the end of the eighties.

3. The stage of decay: from that time on to about the year 1900.

4. The final stage: the first decade of the new century.

I am not by choice a prophet, least of all regarding the weather. But I think it may not be doubted that the fine weather, at least, has passed for Darwinism. So having carefully scanned the firmament of science for signs of the weather, I shall for once make a forecast for Dar-

winism, namely: Increasing cloudiness with heavy precipitations, indications of a violent storm, which threatens to cause the props of the structure to totter, and to sweep it from the scene.

CHAPTER III.

As further witnesses to the passing of Darwinism, two botanists may be cited; the first is Professor Korschinsky who in No. 24, 1899, of the *Naturwissenschaftliche Wochenschrift* published an article on "Heterogenesis and Evolution," which was to be followed later by a large work on this subject. With precision and emphasis he points to the numerous instances in which there occurs on or in a plant, suddenly and without intervention, a variation which may become hereditary under certain circumstances; thus during the last century a number of varieties of garden plants have been evolved. On the basis of such experiments Korschinsky developed the theory which had been proposed by Koelliker in Wuerzburg thirty years earlier, namely, the theory of "heterogeneous production" or heterogenesis," as Korschinsky calls it. When one understands that a plant gives rise suddenly and without any intervention to a grain of seed, which produces a different plant, it becomes evident that all Darwinistic speculations about selection and struggle for existence are forthwith absolutely excluded. The effect can proceed only from the internal vital powers inherent in the specified organism acting in connection, perhaps, with the internal conditions of life, which suddenly exert an influence in a new direction.

Korschinsky distinguishes clearly and definitely between the principles of Heterogenesis and Transmutation (gradual transformation through natural selection in the struggle for existence), and in so doing comes to a complete denial of Darwinism.

The other naturalist who has dealt Darwinism a telling blow is the botanist of Graz, Professor Haberlandt.

He published some very interesting observations and experiments in the "Festschrift fuer Schwendener" (Berlin 1899, Borntraeger). They are concerned with a Liane javas of the family of mulberry plants (Conocephalus ovatus.) The free leaves possess under the outer layer, a tissue composed of large, thin-walled, water-storing cells; flat cavities on the upper side, having, furthermore, organs that secrete water, which the botanist calls hydathodes. These are delicate, small, glandular cells over which are the bundles of vascular fibres (leaf-veins) that convey the water to them; over these in the top layer are so-called water-crevices through which the water can force itself to the outside. It is unnecessary to enter upon a closer explanation of the anatomical structure of these peculiar organs. The water which is forced upward by the root-pressure of the plant is naturally conveyed through the vascular fibres into the leaves and at every hydathode the superfluous water oozes out in drops, a phenomenon which one can also very nicely observe e.g. on the "Lady's cloak" (Alchemilla vulgaris) of the German flora. A portion of the night-dew must be attributed to this secretion of water. On the Liane, then, Haberlandt observed a very consider-

able secretion of water: a full-grown leaf secreted during one night 2.76 g. of water (that is 26 per cent. of its own weight.) Through this peculiarity the water supply within the plant is regulated and the danger avoided that any water should penetrate the surrounding tissue in consequence of strong root-pressure,—which would naturally obstruct the vital function of the entire leaf. Besides it is to be noticed that in this way an abundant flow of water is produced: the plant takes up large quantities of water from the earth, laden with nutritive salts, and the distilled water is almost pure (it contains only 0.045 g. salts), so that the nutritive salts are absorbed by the plant.

From these considerations it necessarily appears that the hydathodes are of great biological importance to the plant.

Haberlandt then "poisoned" the plant, by sprinkling it with a 0.1 per cent sublimate solution of alcohol. The purpose of this experiment was to ascertain whether in the secretion of water there was question of a merely physical process or of a vital process. In the first case the action of the hydathode should continue even after the treatment with the sublimate solution, while in the latter case it should not. As the secretion ceased the obvious conclusion to be deduced from this experiment is that the hydathodes do not act as purely mechanical filtration-apparatuses, as one might have thought, but that there is here evidence of an active vital process in the plant; the unusual term "poisoning" is therefore really justified under present circumstances.

Let me dwell for a moment on this result, for, although it may be somewhat foreign to our present purpose and to the further observations of Haberlandt, it is very significant in itself. The water moves in the plant in closed cells, as the cells of the aqueous gland are entirely closed, but the organic membrane, as every one knows, has the peculiar physical property of allowing water to pass through, the pressure, of course, being applied on the side of least resistance; when therefore the water is forced into the cells by root-pressure, it is easily intelligible that according to purely physical laws it should come to the surface of the leaf on the side of the least resistance, that is, by way of the water-crevices. Even the defenders of "vital force" would not find any reason in this for not considering the phenomenon of distillation in this case a purely physical phenomenon. And still according to Haberlandt's experiments it is not. The sublimate could at most only impede the process of filtration, but should under no circumstances have destroyed it. But it does destroy it, and the hydathode dies. The conclusion certainly follows from this that this process is connected with some vital function. Even if the hydathode is treated with sublimate solution, all the conditions for mechanical filtration still remain: the earth has moisture which can be taken up by the roots so that root-pressure still exists. The water is in all cases conveyed to the hydathodes through the vascular fibres, the cell walls of the hydathodes are still adapted for filtration, and yet they do not filter. Hence some other factor must join itself to the physico-mechanical

process of filtration and affect or destroy it, and this factor can be found only in the protoplasm, the vital element of the cells; for we know that the sublimate acts with pernicious effect on it and in such a manner that it destroys its entire power of reaction; it kills it, as we say.

The experiment under discussion has, therefore, great significance for our view of the vital processes in the plant; it proves beyond doubt that these processes are in no way of a purely mechanical nature, but that there is something underlying all this, a hitherto inexplicable something, which we call "life." In all vital activities, physical and chemical processes certainly do occur; they do not, however, take place spontaneously but are made use of by the vital element of the plant to produce an effect that is desirable or necessary for the vital activity of the plant. If the vital element is dead, no matter how favorable the conditions may be for chemical and physical processes, these do not take place and the effect necessary for life is not obtained. It is very remarkable after all that according to the experiment of Haberlandt this peculiar relation should become apparent in a process that is so open to our investigation as the filtration of water through the cell-wall of a plant.

After what has been said I consider this simple experiment of Haberlandt of great significance; for it is a direct proof of the existence of a vital force. One may resist to his heart's content, but without avail; vital force is again finding its way into science. More and more cognizance

is being taken of the fact that 60 and 70 years ago people jumped at conclusions very imprudently when they believed that the first artificial preparation of organic matter (urea, by Woehler) had proven the non-existence of a vital force. Since then there has been great rejoicing in the camp of materialists who scoffed at the "ignorant" who would not as yet forsake vital force. "Behold," they said, "in the chemist's retort the same matter is produced chemically that is produced in the body of the animal, without the direction of a hidden vital force, which, if it is not necessary in the one case, neither is it necessary in the other." Any one who had given the matter careful consideration could even at that time have known where the "ignorant" really were. That in both cases chemical processes take place is clear and undisputed, but the materialists forgot entirely that even in the laboratory it was not the mere contact of the elements that produced the urea; a chemist was needed and in this case not any one arbitrarily chosen, but a man of the genius and knowledge of a Woehler to watch over the process, and utilize and partly direct the laws of chemistry in order to obtain the desired result. Hence it was even then absurd to deny vital force as a consequence of that experiment. Since, however, it was well-adapted for materialistic purposes, this denial was proclaimed with the sound of trumpet throughout the land, and repeated again and again with surprising tenacity, with the result that even thoughtful investigators rejected vital force almost universally in the seventies and eighties.

It has always been a problem to me how this could have happened. It can, indeed, be explained only on the supposition that naturalists were adverse to the introduction of anything into nature, that appeared to them mystical and mysterious. Nor is such a procedure at all necessary: vital force is by no means a mysterious, ghostly power that soars above nature, but a force of nature like its other forces, as mysterious and as definite as they are, only that it dominates a specified group of beings, namely, living organisms. It may readily be compared with any other natural phenomenon. For instance, the phenomenon of crystalization has its well determined sphere of activity, viz., the mineral world. It employs definite mathematico-physical laws to obtain a specified result, and even acts differently in different mineral substances in so far as it produces in the one case this, in the other case that form; but still it should be a similarly directed force which has the effect of producing these peculiar forms. Precisely similar is it with vital force. It has its determined sphere of activity, the kingdom of living organisms; it acts according to definite physico-chemical laws in producing a specified result; it acts differently in different living organisms; it is therefore a force of nature as clear yet as mysterious as the force of crystallization or as any other force of nature. Hence one has no cause to complain of its mysteriousness, for all other forces of nature are just as much, or if you will, just as little mysterious as vital force. The only thing to be maintained is this, that living organisms are domi-

nated by a special force with special phenomena and special activities, even as in mineral substances there is a special dominant force which produces special phenomena and exercises special activities.

It is possible to produce crystals in the laboratory, but no one will be so foolish as to maintain that in nature crystals are not formed in consequence of a very definite force inherent in the mineral-substances; nor will any one deny the existence of the force of crystallization because it does not appear in living organisms.

Nor have I ever despaired of a return of the theory of vital force. A change of opinion has really taken place during this decade; at present the voices for a vital force are constantly growing stronger and it will most probably not be very long before it will be again universally recognized, not as something preternatural, of course, but as a force of nature on an equal footing with the other forces of nature, with activities, just as mysterious and just as well-attested as the activities of the other forces of nature.

Haberlandt's experiment, however, had also an indirect consequence that is of far-reaching importance. He observed that within a few days new water-secreting organs of an entirely different structure and of different origin were formed on the leaves that had been sprinkled with sublimate. Over the bundles of vascular fibres, little knots as large as a pin head arose in larger numbers out of a tissue underlying the top layer; out of these the water now oozed every morning. Closer investigation disclosed the

fact that these organs develop only on young immature leaves where groups of peculiar, perishable gland-hairs are found; beneath these dead mucous glands the substitute secretive organs originate in the inner tissue. It is of no importance to state in what particular cells they originate.

Suffice it to say that they are colorless capillary tubes originating in various cells; projecting like the hairs of a brush, containing living protoplasm and evanescent chlorophyl. It is also important to note that this new organ is immediately connected with the water-conducting system consisting of bundles of vascular fibres. Haberlandt furthermore indicates especially that these organs when viewed in connection with the process of secretion give evidence of an active vital principle as well as of simple mechanical filtration.

These substitute organs are all indeed well adapted to their purpose and adequately replace the old secretive organs, but they so easily dry out and are so little protected that after a week they become parched and die because wound-cork forms under them. The leaf no longer produces new hydathodes, but on its lower side it produces growths that function as vesicles, by means of which it continues to sustain itself.

Haberlandt furthermore records a phenomenon perhaps analogous to this on the grape-vine, but with this exception the case described by him is unique. In order to pass any further judgment regarding it, we should have to ascertain whether the whole phenomenon is not a case

of so-called adaptation; if so, processes should be found in nature, analogous to the poisoning of the hydathodes in this experiment, which result in the destruction of the hydathodes so that in consequence the plant would have gained the power of making good the loss, by means of the substitute organs. Such processes, however, (even through poisoning or through parasites) would be very highly improbable. Equally incredible is the alternative possibility that the new organs would be produced by the plant not as a substitute but as a supplementary apparatus when the old ones would not suffice for secretion in case of very large absorption of water. This also must doubtlessly be rejected, as Haberlandt has observed.

Powers of adaptation should, of course, according to Darwinism, be gradually acquired in the struggle for existence, as in that case they should also have stability; but since this is not possessed by the new organs, the presumption is that they do not possess the character of adaptation. They are therefore new organs that originated after an entirely unnatural and unforseen interference with the normal vital functions and in consequence of a self-regulating activity of the organism.

What then is there in the whole phenomenon worthy of notice with regard to the theory of Descent?

1. An immediately well adapted new organ has here originated very suddenly without any previous incipient formation, without gradual perfection and without stages of transition.

2. In its formation struggle for existence and natural selection are entirely excluded, neither can find any application whatever even according to the newer exposition of Weismann. Haberlandt himself draws this conclusion.

3. If this phenomenon of a suddenly appearing change can take place in the course of the development of the individual, there can be no obvious reason why it should not take place in the same manner (without natural selection or struggle for existence) in the course of the phylogenetic development.

It is manifestly of the greatest importance that in this case a direct, experimental proof has been given that an organ has originated suddenly and without the aid of Darwinian principles. Haberlandt's article is nothing less than a complete renunciation of Darwinism on the part of Haberlandt, a renunciation which we greet with great satisfaction.

In fact one such observation would really suffice to set aside Darwinism and prove the utter insufficiency of its principles to give explanation of the origin of natural species. On the other hand, this observation plainly proves two things: first, that the above mentioned doctrine of Koelliker, now held by Korschinsky is a move in the right direction for the discovery of the causes of descent; and secondly, that the principal cause of the evolution is not to be sought in environment and blind forces but in the systematically working, internal vital principle in plants and animals. With that, however, an important part of the foundation of the mechanical-materialistic view of the world is demolished. Still not.

CHAPTER IV.

Since we have heard the verdict of zoologists and botanists concerning Darwinism, it is but right that we should now listen to a palaeontologist, a representative of the science, which investigates the petrified records of the earth's surface, and strives to collect information regarding the world of life during remote, by-gone ages of the earth. It is evident to every one that the verdict of this science must be of very specal importance in passing on the question of the development of living organisms. Darwin himself recognized this at the outset. He and his followers, however, soon perceived that, while the revelations of palaeontology were on the whole favorable to the doctrine of Descent, in so far as they proved the gradual change of organization, in consecutive strata, from the simple to more complex forms, palaeontology revealed nothing that would sustain the Darwinian theory as to the method of that development. As soon as the Darwinians, and first of all Darwin himself, perceived this, they at once brought forward a very cheap subterfuge. Since Darwinism postulates a very gradual, uninterrupted development of living organisms, there must have been an immense number of transition-forms between any two animal or plant species which to-day, although otherwise related, are separated by

characteristic features. Consequently, on the Darwinian hypothesis, all of these transition-forms must have perished for the singular reason that other better organized forms overcame them in the struggle for existence. If therefore the millions of transition-forms were still missing, and the known petrified forms of older strata of the earth did not reveal them, the Darwinians were able to console themselves until from 20 to 40 years ago, with the assertion that our knowledge was still too deficient, that a more thorough investigation of the earth's surface and especially of out-of-the-way parts would eventually bring to light the supposed transition forms. Such assertion affords very poor consolation, and is anything but scientific. The method of natural science consists in establishing general principles on the basis of the materials actually furnished by experiments and observation and not in excogitating general laws and then consoling oneself with the thought that while our knowledge of nature is as yet extremely imperfect, time will furnish the actual material necessary to substantiate our guesses. But since then many a year has come and gone and Darwinism has caused, and for that alone it deserves credit, a diligent research in every field of natural science, and has promoted among palaeontologists a search for the missing transition-forms. The materials of investigation from the field of palaeontology have also wonderfully increased during these decades. Hence it is worth while now at the dawn of the new century to examine this material with a view to its availableness for the theory of Descent and especially for Darwinism.

Professor Steinmann has recently done so in Freiburg in Breisgau, on the occasion of an address as Rector of the University. What conclusions did he reach?

Steinmann declares it to be the primary task of post-Darwinian palaeontology "to arrange the fossil animal and plant-remains in the order of descent and thus to build up a truly natural, because historically demonstrable, classification of the animal and plant-world." At the outset it is to be noted that for various reasons palaeontology is unable to execute this momentous task in its full extent. The evidence of palaeontology is deficient, if for no other reason than that many animal organisms could not be preserved at all on account of their soft bodies; many animal groups have, nevertheless, received an unusual increase (mollusks, radiata, fish, saurians, vertebrates, and dendroid plants).

As regards the attempt made in the sixties to draw up lines of descent, Steinmann repudiates, without, of course, mentioning names, the family tree constructed by Haeckel and his associates as wholly hypothetical and hence unjustified; he rightly remarks that their method smacks of the closet. He finds fault with them chiefly because they predicated actuality of this imaginary family-tree and fancied that the historical research of the future would have but isolated facts to establish.

In speaking of the palaeontological research of the last few decades, Steinmann says: "In the light of recent research, fossil discoveries have frequently appeared less intelligible and more ambiguous than before, and in those

cases in which an attempt has been made to bring the descent-system into agreement with the actual facts, the incongruity between the two has become obvious." Thus, for instance, the well-known archaeopteryx is not, as was maintained, a connecting link between reptile and bird, but a member of a blindly ending side branch. In fact palaeontological research has proven incapable of finding the transitions between different species, clearly determined by the theory. But the overwhelming abundance of matter called for new endeavors to master it. It was then further discovered—Steinmann finds an illustration of this fact in the echinodermata—that the well-known "fundamental law of biogenesis" of Haeckel can be accepted only in a very restricted sense and may even lead to conclusions absolutely false. We desire to remark here that a "fundamental principle" should never mislead; if it does so, it is not a fundamental principle.

It is of importance to know that according to palaeontological investigation, empiric systematizing and phylogenetic classification do not always coincide, as, for instance, in the case of the ammonites. Acording to palaeontological investigation the great systematic categories are only grades of organization. Hence present day systematizing is being more and more discarded, and the said categories —as indeed also the lesser groups of forms—must be of polyphyletic origin, that is, they must have descended from different primitive stocks. It may be asked: What bearing has this principle of multiple origins? For a long time reptiles were the predominating vertebrates; when mammals

and birds appeared, numerous, varied and strange saurians inhabited land and sea; but "with the end of the chalk-period most saurians seem to have vanished suddenly from the scene, and soon we behold the mainlands and oceans inhabited by mammals of most diverse kinds." The saurians have become almost extinct and the mammal-tribe suddenly shows a most extraordinary variability and power of development. How is either phenomenon to be explained?

"The disappearance of a group of organisms has been preferably explained since the time of Darwin, by defeat in the struggle with superior competitors. If ever an explanation lacked pertinency, it does so in this case, in which the succumbing group is represented by gigantic and well preserved animal forms, widely distributed and accustomed to the most varied methods of nutrition, whereas the competitor appears in the form of small, harmless marsupials. It would be equivalent to a struggle between the elephant and the mouse." And the mouse wins.

We acknowledge with pleasure this clear rejection of Darwinism on the part of Steinmann.

Steinmann also rejects the natural extinction of those forms, perhaps from the weakness of old age; whether he is wholly warranted in doing so, seems somewhat doubtful. He tries to explain the phenomenon on the basis of the multiple origin of the mammals; and in fact there is already speculation regarding triple origin, viz: tambreets, marsupials, and the other mammals. Now if the latter also

possessed a multiple origin, the problem of the extinction of the saurians would, according to Steinmann solve itself. One would not need to consider the number of extinct forms as large as is now done. However, he does not enter upon any closer consideration of this question. But he points out, for instance, that to-day the shells of mollusks (snails and conchylia) are regarded as structures that were acquired only in the course of time for the sake of protection, the disappearance of which, therefore, implied a disadvantage for the respective organisms. This transition would be something extraordinary—"but if on the contrary, one regards the shells as the necessary products of a special kind of assimilation and of the immoveableness of certain parts of the body, the gradual disappearance might well be considered a process which may take place in various animal-groups with a certain regularity in the course of the phyletic development." The snails devoid of shells, for instance, may be derived with certainty from those possessed of shells; this process has very probably also taken place in different genetic lines.

This view is well worth consideration; it stands in sharp opposition, in fundamental principles, to the Darwinian explanation. This calls for special emphasis here. How should one explain the origin of uncrusted mollusks from crusted ones through the struggle for existence, since in such a contest the latter must have had far greater prospect of survival than the former?

This view together with the principle of multiple origin opens up, according to Steinmann, "the prospect of

an altered conception of the process of formation of the organic world." According to the new conception, the many extinct forms of antiquity are not, as Darwin supposed, "unsuccessful attempts and continued aberrations of nature"—how this reminds one of that old, naive, much-ridiculed idea that fossils were models that God had discarded as unserviceable—but would gain new life and assume hitherto unsuspected relationship to the present organic creation.

"Science, which seeks after operative causes, at the beginning of the century regarded creation as a multiplicity of phenomena without any causal connection as to their origin. Darwin taught as a fundamental principle the unity and the causal inter-relation of creation, but was not entirely able to save this hypothesis from a violent and sudden death. In the future sketch creation will appear as wholly restricted in itself and lasting, the causes of its limitation lie, up to the time of the intervention of men, solely in the balanced motion of the planet which it peoples."

At the close of his address Steinmann points out that behind the problem of the manner of development, there stands "the unsolved question regarding its operative causes." "Regarding this point," he continues, "opinions have perhaps never been so divergent as they are to-day. The times have passed when the Darwinian explanations were regarded with naive confidence as the alpha and omega of the doctrine of Descent. Not only are the adherents of Darwinian ideas divided among themselves, but

the theory of Lamarck, somewhat altered, favored by the results of historical investigation, appears more striking and now seems more in harmony with facts than formerly. What is considered by one as the ruling factor in the evolution of organisms is regarded by another as a "quantite negligeable" or even as the greatest mistake of the century. In this discord of opinions the principle of Descent alone forms the stable pole."

Thus Steinmann, and we can but applaud his conclusions with undisguised pleasure, for they tend throughout in the direction of our anti-Darwinian view, and deal Darwinism another fatal blow. It is also worthy of special note that this time the blow is dealt from the side of palaeontology; for, even if now and again we dissent from Steinmann, in this we fully agree with him that the historical method of considering the evidences of bygone periods of creation is at the very least quite as important for passing correct judgment regarding descent, as is the investigation of contemporary living organisms. Indeed, family-trees were constructed without regard for palaeontology, almost exclusively from an examination of present conditions, and sometimes the author did not even shrink from falsification. This procedure has been bitterly revenged and will take further revenge unless at length a definite end be put to the family-tree nuisance and the respective books instead of being published anew, be relegated to the lumber-room of science, there to turn yellow amid dust and cobwebs— the curious evidence of gross folly. But only have patience, even that time will come.

The conclusions of Steinmann, that are most important for us, may be summarized as follows:

1. The family and transition forms demanded from palaeontology by Darwinism for its family-trees, constructed not empirically but *a priori*, are nowhere to be found among the abundant materials which palaeontological investigation has already produced.

2. The results of the investigation do not correspond with the family groups drawn up according to the so-called "biogenetic principle," which principle has in fact led men of science into false paths.

3. At best, the biogenetic principle has a limited validity, (we add that later it will undoubtedly follow Darwinism and its family trees into the lumber-room).

4. The results of palaeontology, in so far, for instance, as they testify to the sudden disappearance of the saurians and the advent of mammals, everywhere contradict the Darwinian principle of the survival of the fittest in the struggle for existence.

5. "The time has long passed when the Darwinian explanations were regarded with naive confidence as the alpha and omega of the doctrine of Descent."

6. Only the principle of Descent is universally recognized; the "how" of it, its causes, are to-day entirely a matter of dispute.

CHAPTER V.

The strongest evidence of the decay of Darwinism is to be found in the fact that, since Darwin first enunciated his theory, many and diverse attempts have been made to explain the origin of species on other principles. Names of men, like M. Wagner, Naegeli, Wigand, Koelliker, and Kerner mark these attempts; but of these investigators Naegeli alone proposed a well-developed hypothesis. Finally, however, Eimer, professor of zoology in Tuebingen came forward with a detailed theory of Descent. As early as 1888 he published a comprehensive work dealing with it, under the title: "The Origin of Species by Means of the Transmission of Acquired Characters According to the Laws of Organic Growth." As the title itself indicates, a very marked divergence was even at that time manifesting itself between Eimer and his former teacher and friend, the great defender of Darwinism in Germany, Aug. Weismann, professor of zoology in Freiburg in Breisgau. For, while the latter vigorously attacks the transmission of acquired characters, Eimer's whole theory is founded on this very transmission. Observations regarding the coloring of animals, in fact, form the basis of Eimer's theory.

Eimer attributes the origin of species to "organic growth" by which he means not merely increase in size, but also change of form, etc. This growth does not pro-

ceed blindly or aimlessly, but proceeds on rigidly determined lines, which depend upon the structure and constitution of the particular organism. External influences, however, also affect it. Eimer specially emphasizes four points in this connection: 1. This rigidly determined development of a character exhibits well defined, regular stages, and the evolution of each individual repeats the whole series of transformations (the Mueller-Haeckel "biogenetic-law." 2. New characters are first acquired by strong adult males (the law of male dominance). 3. New characters appear on definite parts of the body, spreading especially from the rear to the front, (the law of undulation). 4. Varieties are stages in the process of development, through which all the individuals of the respective species must pass. Non sense

These points indicate how important for Eimer is the transmission of those characters which the parents themselves have acquired in the course of their own development. He conceives that this transmission takes place when the causative influences exert themselves permanently on many succeeding generations. Eimer thinks that in this way the constitution of the respective species is gradually transformed. Besides the effect of external influences (which may vary according to the climate, etc.: Geoffroy St. Hilaire), Eimer mentions as important and active factors in this development, (1). The use and disuse of organs (Lamarck); (2). The struggle for existence (Darwin); (3). The correlation of organs, that is, the inner relation of organs in consequence of which a change in one organ may

occasion a sudden change in another organ; (4). Cross fertilization and hybridism. Non Hered. de Lam

It is clear that with reference to the factors of evolution Eimer is, and perhaps not unreasonably, an eclectic, whose aim is to do justice to the predecessors of Darwin as well as to Darwin himself. His antagonism to Darwin and Weismann in this work is still quite moderate, although even here it appears with sufficient clearness that selection and the struggle for existence, the two principles peculiarly characteristic of Darwinism, do not give rise to new species, but can at best only separate and differentiate species already existing.

The second part of Eimer's work dealing with the origin of species, which appeared after an interval of ten years, bears the title: "Orthogenesis of Butterflies." The Origin of Species, II. Part (2 tables and 235 illustrations in the text). Leipzig, 1897. In this book substantially the same thoughts occupy the mind of the author as in the former volume, but in many respects they are more mature, and conspicuously more definite and precise. The most salient features are the following:

1. Eimer establishes his theory by means of very minute observations on a definite species of animals, viz., butterflies.

2. He attributes evolution almost exclusively to development along definitely determined lines.

3. He proves the utter untenableness of Darwinian principles and repudiates them unqualifiedly.

4. In a very distinct and severe manner he gives expression to his opposition to his former friend Weismann.

5. He attacks with telling effect the fantastic Darwinian "Mimicry."

In his "General Introduction" Eimer first treats of Orthogenesis in opposition to the Darwinian theory of selection. The very first sentence gives evidence of this antagonism: "According to my investigation, organic growth (Organophysis), which is rendered dependent on the plasm by permanent external influences, climate and nourishment, and the expression of which is found in development along definitely determined lines, (Orthogenesis), is the principal cause of transformation, its occasional interruption and its temporary cessation and is likewise the principal cause of the division of the series of organisms into species."

Lamarck's theory of the use and disuse of organs and Darwin's hypothesis of natural selection are consequently pushed into the background. Here also Eimer at once places himself at variance with Naegeli who had enunciated a similar theory. Naegeli took as a starting point an inherent tendency in every being to perfect itself, thus presupposing an "inner principle of development," and making light of external influences as transforming causes. Eimer flatly contradicts this view. We shall revert to this point in our criticism of his theory. In opposition to the theory of selection, Eimer lays special stress on the fact that its underlying assumption, viz., fortuitous, indefinite variation in many different directions, is entirely devoid of foundation

in fact, and that selection, in order to be effective, postulates the previous existence of the required useful characters, whereas the very point at issue is to explain how these characters have originated. Since, therefore, according to Eimer's investigations, there are everywhere to be found only a few, definitely determined lines of variation, selection is incapable of exercising any choice. The development, furthermore, proceeds without regard for utility, since, for instance, the features that characterize a species of plants are out of all reference to utility. "Even if nothing exists that is essentially detrimental, nevertheless very much does exist that bears no reference whatever to immediate good, and was therefore never affected by selection."

Further on, Eimer expresses still more clearly the opposition of his theory to that of Darwin, and in so doing he attacks vigorously the omnipotence of selection, so unreasonably proclaimed by the followers of Darwin. Eimer's theory, consequently, asserts that: "The essential cause of transmutation is organic growth, a definite variation, which, during long periods of time proceeds unswervingly and without reference to utility, in but few directions and is conditioned by the action of external influences, of climate and nourishment." In consequence of an interruption of orthogenesis a stoppage ensues in certain stages of the development, and this stoppage is the great cause of the arrangement of forms in different species. Of vital importance also "is development through different stages (Hetero-epistase), which results in the arrested devel-

opment of certain characters in an organism, while others progress and still others become retrogressive. As a rule use and disuse are of great efficacy in this regard, and conjointly with these compensation and correlation." Occasionally also irregular development sets in, which proceeds by leaps.

Of course, Eimer could not but in his turn burn incense before Darwin by declaring that he would not dare to cross swords with such a man, while in reality he repudiates all of Darwin's fundamental tenets.

It may be well to state here in addition a few important supplementary considerations: "Development can everywhere proceed in only a limited number of directions because the constitution, the material composition of the body, conditions these directions and prevents variation in all directions." This is an important statement because Eimer clearly expresses therein the difference between his own theory and that of Naegeli. He makes the direction of development dependent on the material composition of the body, whereas Naegeli considers it dependent upon an internal tendency of every being to perfect itself, hence upon a power inherent in the body. Eimer's view therefore tends towards a mechanical explanation, while Naegeli postulates a vital energy. The "internal causes" according to Eimer find their explanation in the material composition of the body. Since the growth of the individual organism depends on this composition and on the external influences, Eimer compares family-development with it and designates the latter as "organic growth." In opposition to Naegeli

he maintains that this "organic growth" does not always aim at perfection but often tends to simplification and retrogression.

The following, then, according to Eimer, are the directive principles of variation: (1). The general law of coloration (stripes running lengthwise change into spots, stripes running crosswise change to a uniform color). (2). The law of definitely directed local change (new colors spread from the rear to the front and from above downward or vice versa, old colors disappear in the same directions. (3). The law of male predominance (males are as a rule one step in advance of the females in development). Female predominance is an exception. (4). The law of age-predominance (new characters appear at a well-advanced age, and at the time of greatest strength). (5. The law of wave-like development (during the course of the formation of the individual organism a series of changes proceed in a definite direction over the body of the animals). (6). The law of independent uniformity of development (the same course of development is pursued in non-related forms and results in similar forms). (7). The law of development through different stages (different characteristics of the same being may develop to a different degree and in different directions). (8). The law of unilateral development (the progeny does not present a complete combination of the characters of the parents but manifests a preponderance of the characteristics of either parent). (9). The law of the reversal of development (the direction of develpoment may reverse and tend towards the

starting point). (10). The law of the cessation of development (a protracted cessation of development frequently ensues in one or the other stage).

The origin (perhaps rather the distinction) of species is accounted for principally by the last named law, by means of which Eimer also explains the so-called atavism or reversion. To this law are joined other factors, e. g., development proceeding in leaps, as demonstrated by Koelliker and Heer; local separation (through migration; prevention of fertilization, e. g., the impossibility of cross-fertilization between certain individual organisms (which Romanes had already opposed to natural selection), and crossing.

The second main division of the book is taken up with a very searching and detailed criticism of Weismann. This criticism seems to me entirely warranted; because not only the latter's unintelligible position with regard to natural selection (the repudiation of which he seems to regard as synonymous "with cessation of all investigation into the causal nexus of phenomena in the domain of life") but likewise his fanciful theory of heredity, utterly devoid as it is of any support from actual observation, bespeak an utter lack of qualities essential to a naturalist; and the manner in which he ignores his former pupil and his labors, because they proved embarrassing to him, is entirely unworthy of a man of science.

Eimer devotes special attention to "mimicry"; and indeed he was forced to be very solicitous to dispel this fanciful conception of Darwinism which radically contradicted

his own views. Moreover, the untenableness of the mimicry hypothesis must have revealed itself very clearly to him in the course of his investigations regarding the coloring of butterflies. Mimicry, as our readers are well aware, consists in this, that living beings imitate other organisms or even inanimate objects; Darwinism maintains that this is done for the sake of protection against enemies. This phenomenon is said to have been produced by selection Those animals that possessed, for instance, some similarity to a leaf, in consequence escaped their enemies more easily than others and survived, while those that had no leaf-like appearance succumbed; when this process had been repeated a few times, many animals (butterflies) gradually developed that marvelous leaf-like appearance, which frequently deceives the most practiced eye.

It appears so simple and natural that one need not wonder that this peculiar phenomenon gained many an adherent for Darwinism. But, of course, it is directly opposed to the views of Eimer; and it is for this reason that he endeavors so assiduously to disprove the error of Darwinism in this regard. As the underlying color design of the butterfly Eimer designates eleven longitudinal designs; and the examination of the leaf-like forms leads him to the conclusion, that their appearance always depends on "the unaltered condition or the greater prominence of certain parts of this fundamental design." There is to be observed a shifting of the third band, so that in conjunction with the fourth, which is curved, it forms the mid-rib of the leaf. Eimer finds the cause of this phenomenon in the alteration

of the form. The leaf-like form results from an acumination and elongation of the wings, which in turn results from a marked elongation of the rim of the fore-wing. And this again is produced by the proportionately greater growth of one part of the wing-section than of the others.

With reference to the reason of this growth it is of importance to note that experiments, consisting in the application of artificial heat to the chrysales of the swallow-tail and sailor-butterfly, demonstrated that by this means "the fore-wing is drawn out more toward the outer wing-vein, and the rim of the fore-wing becomes more elongated and curved." It is observed, however, that the natural heat-forms of the same genera and species, namely, the summer-forms and those which live in the warm southern climate, exhibit, for instance, in the case of butterflies akin to the sailor, the same features, the elongation and more marked curvature of the fore-rim of the fore-wings and the consequent more extended form, that are produced by the action of artificial heat. Manifestly this is a matter of vital importance for the solution of the question: heat, whether artificial or natural, produces a difference in growth, which results in a change of form and coloring. There is consequently no room for natural selection or the struggle for existence.

The leaf-like form is generally associated with the dark, faded colors of dry leaves, and when this similarity disappears even bright colors appear on the fore-wings. In many cases the resemblance to leaves is very imperfect;

different forms of the same species live side by side and among them are to be found those, the resemblance of which to leaves is extremely slight. All these facts, and especially the frequently recurring retrogression of the leaf-like appearance, justify serious doubt regarding the Darwinian assumption, that adaptation was a necessity for the forest-butterflies on account of the protection which it provided.

An eye witness furthermore declares that the butterflies that resemble leaves most closely do not always alight on withered leaves, on which they would be almost invisible, but frequently rest on a green background, against which they show off very clearly, and therefore could not long escape the keen eye of birds. Besides, these butterflies are but seldom pursued by the birds, of which there is question here, and hence are in no need of protection.

The longer Eimer devoted his attention to the origin of this resemblance the more "the poetic picture of the imitated leaf" vanished out of sight, and he became convinced that it involved the necessary expression of the lines of development, which the respective beings were bound to follow, and that there was no question of imitation.

Apart from the resemblance to leaves, by reason of regular changes of color, design, and wing-structure, numerous non-related butterflies often develop such wonderful similarities—which are not, as hitherto supposed, imitations or disguises produced by selection, but are either the outcome of an entirely independent uniformity of development or, at least, of its consequence—that it must be

admitted that external similarity may arise by different means and in various ways. These relations of similarity are of such frequent recurrence because of the limited number of directions of development in which changes or color and design in butterflies may tend. Eimer finds the reason of this small number of directions, in which development may proceed, in the fact "that the elementary external influences of climate and nourishment on the constitution of the organism are everywhere the cause of the transformations."

Another important point is the difference of sex. If the butterflies are of different sex, the males as a rule exhibit a more developed stage of design and color than the females. These frequently present on the upper side the stage of coloration, which the males present on the lower side, while the upper side of the males is one stage in advance. It is of special significance that the characters of the more advanced sex frequently correspond to those of a related, superior species, and occasionally to those of widely separated species. Eimer endeavors to explain male predominance "by a more delicate and more developed, i. e., more complex, chemico-physical organization of the male organism." Even this development tends toward simplification, the origin of dull-black colors.

This most interesting question brings Eimer into conflict with another Darwinian principle, the so-called principle of "sexual election," according to which the more striking characteristics of the male sex become strengthened for the reason that females invariably give the prefer-

ence to the males endowed with them, over those that are less "attractive." These exceedingly romantic ideas have been often and deservedly repudiated, e. g., even by Wallace only a short time after their first appearance. Eimer really does them too much honor when he again undertakes, even with a certain amount of respect, a thorough refutation of them, "as in every regard unfounded." It is of primary importance to note here, that in the case of dimorphism of the sexes abrupt modifications occur in connection with unilateral heredity. "It is impossible for sexual selection to produce a change of design and color, which results in the sudden kaleidoscopic formation of wholly different designs, as we find actually taking place through the action of artificial heat and cold and other factors in nature."

This brings us to a brief consideration of the answer, which Eimer proposes to give to the question of the real causes of the formation of species among butterflies. A precise and clear statement of this important part of Eimer's theory of Descent, is contained in the following extracts: "The transformation of organisms is primarily conditioned by the action of immediate external influences on the organisms. The same causes, which produce individual growth, especially climate and nourishment, also produce the organic growth of organisms, that is, transmutation, which is but a continuation in the progeny of individual growth, through the transmission of the characteristics acquired during the lifetime of the individual.

Hence, transmutation is simply a physiological process, a phyletic growth.

The changes, which the individual organism experiences during its life in its material, physiological and morphological organization, are in part transmitted to its progeny. The changes thus acquired become more marked from generation to generation, until finally they result in a perceptible new structure." NEVER

"In this process, new or changing external influences undoubtedly exercise great activity, but the same influences, constantly repeated, must in the course of time also produce a change in the organisms through the physiological activity, which is conditioned by them, so that after a long time elapses, a species will have changed even in an unvarying environment and will react on new influences in a manner quite different from their progenitors; their "constitution" has undergone a change." How?

"This organic growth of living beings takes place regardless of the active use of the organs and in many cases remains independent of this (Lamarckian) factor of transformation. But use may exercise considerable influence on the formation resulting from the primitive organic growth, by modifying the growth, by restricting it to those parts most frequently called into use, or even by depriving other parts of the necessary matter (compensation)."

"The Lamarckian principle, therefore, offers but a possible and to transformation, the principal cause is to be found in organic growth."

"* * * The organic growth of butterflies is primarily conditioned by climatic influences. * * * The proof is to be found in the facts revealed by the geographical distribution of butterflies, by the variations corresponding to the seasons, and by experiments regarding the influence of artificial heat and cold on development."

Experimental proof is naturally of vital importance for Eimer's theory. He cites in this regard especially the experiments of Merrifield, Handfuss, Fischer, Fickert, and Countess Maria von Linden. In Eimer's own laboratory the latter performed experiments on Papilionides, "which prove in the most striking manner the recapitulation of the family-history in the individual." "The fact that it is possible by raising or lowering the temperature during the time of development to breed butterflies, possessed of the characteristics of related varieties and species living in southern and northern regions respectively, characteristics not merely of color and design, but also of structure, is complete irrefragable proof of my views."

Eimer therefore belongs to the class of naturalists, like Wigand, Askenasy, Naegeli, and many others, who reject the purely mechanical trend of Darwinism and recognize an "immanent principle of development." He seeks the essential cause of evolution in the constitution of the plasm of organisms. This very analogy between the development of the family and that of the individual should, in fact, convince any one of this. If Eimer chooses to refer the analogy to "growth" and to designate the evolution of

the whole animated kingdom as also a process of growth, there is, strictly speaking, no room for objection. However, there is here a danger, which he does not seem to have guarded against. To designate the whole process as a growth, as Eimer does, really explains nothing, but merely defines more clearly the status of the problem. For, what do we know of the so-called process of growth? In truth, nothing, so that very little is gained by referring evolution to organic growth; the problem remains unsolved.

The most important and correct part of Eimer's conclusion seems to be the establishment of definite lines of development. He has, in fact, permanently disposed of the Darwinian assumption of universal chaos in evolution, upon which good mother Nature could at will exercise her choice. Fortuitously initiated development is a conditio sine qua non of Darwinism and Weismannism. For any one, who has studied the work of Eimer and still adheres to this fundamental error of Darwinism, there is no possible escape from the labyrinth into which he has allowed the hand of Darwinism to lead him.

If, on the one hand, Eimer recognizes the immanent principles of development, he, nevertheless, on the other hand, also accords due consideration and ascribes great efficacy to external influences; in fact, he represents them as perhaps the more essential factor. Climate, nourishment, etc., affect the inner structure, the plasm, transform it and thus produce variation which is transmitted to the

progeny. But, however great may be the influence of environment, Eimer seems to overestimate it. Indeed, the analogy of "growth" should have led Eimer to a conception of the true relation between "internal" and "external" causes. Warmth, air, light, moisture and nourishment, are undoubtedly necessary factors in the process of growth, but they are only the conditions which render it possible, and not the causes which produce it. The latter are to be found in the individual organism itself. The conditions may be ever so favorable and well-adapted for growth, still the organism will not develop unless it bear within itself the power to do so. On the other hand, although it is hampered and may become abnormal, it will readily grow even in an unfavorable environment, as long as it retains its inherent vital force. The same is very likely true of the genealogical growth. Evolution took place in virtue of the power inherent in the developing organisms. But only when the environment was favorable and normal, did the evolution proceed favorably and normally, that is, toward the perfection of the animate kingdom.

It appears as if the internal principle of development were losing influence and significance with Eimer; but the ulterior reason for this is not far to seek. Whoever recognizes the validity of the internal principle of development, eliminates chance, that stop-gap of materialism, from evolution, and is lead at once to a supreme Intelligence which directs evolution. As soon as it comes in sight, however, certain persons take fright and turn aside or even turn back in order to avoid it. This was the case with Eimer, al-

though perhaps in a lesser degree. This is sincerely to be deplored, since his theory would have gained in depth if he had but done full justice to the internal principle of development. For the same reason he seems to have attacked Naegeli's principle of perfection, another fact which is very much to be regretted. True, it is as anti-mechanical as it can be and hence has gained but few adherents; but it is based on truth nevertheless, and will some day prevail in the doctrine of Descent.

It is perfectly intelligible that the thought of "perfection" should not have occurred to Eimer or should have slipped his memory during his observations on butterflies. The fact however, reveals a one-sidedness which he could have avoided. When the notion of utility is rejected—and Eimer rejects it very emphatically in his discussions on mimicry—it is undoubtedly difficult to arrive at the concept of a perfecting tendency. This, however, can in no way mean that this concept should be entirely banished from nature, even as the notion of utility cannot be banished. Even if the coloration and design of the wings of the butterfly do not reveal utility, other characteristics certainly do reveal it. It is one of the fatal mistakes of Darwinism, that it fails to recognize the possibility of dividing the characters and qualities of organisms into two large groups, as I attempted to do with more detail, for instance, in my "Catechism of Botany." There I called them (p. 89) "Autochthon-morphological" and "adaptive-morphological characters." The former reveal no relation to utility, they are innate and distinguish the organ-

ism from other organisms; the latter can be explained by means of certain vital functions, hence they possess a certain utility and adapt themselves more or less to environment. The former are permanent, the latter changeable. Darwinians regard all the characters of organisms as useful, physiological, and adaptive. If they have been hitherto unable to make good this assumption, they appeal to our lack of knowledge and console themselves with the thought that the future may yet reveal the missing relations. The presence on plants and animals of any autochthon-morphological characters means death to Darwinism, because these can never be explained by means of selection and struggle for existence. These are the only ways.

Eimer is too much inclined towards the other extreme; he does not admit the existence of adaptive-morphological characteristics. Viewed in this aspect, his repudiation of mimicry may perhaps also seem somewhat harsh and one-sided. In this narrowness of view must also be sought the reason for his complete repudiation of Naegeli's principle of perfection.

It is an incontrovertible fact that in the organic world there exists an ascending scale from the imperfect to the perfect. Every organism is indeed perfect in its own sphere and from its own point of view. But perfection with reference to things of earth is a very relative concept; many an organism which is perfect in itself, appears very imperfect when compared with others. If, then, there is a gradation of animals and plants from the lower to the higher, it is the task of the theory of Descent to explain

this gradual perfection. The crude and aimless activity of Darwinian selection, which necessarily operates through "chance," can never explain this perfection, which remains, as far as selection is concerned, one of the greatest enigmas of nature. Far from solving the enigma, selection but makes it obscurer.

If, then, one refuses to recognize a directing creative Intelligence, whose direction produces this perfection, nothing remains but Naegeli's principle of perfection. The outer world with its influences can certainly not produce perfection, hence this power must lie within the organism itself. But when one has once brought himself to accept an immanent principle of development, it surely cannot be difficult to take the next step and ascribe to it the tendency towards perfection.

That Eimer does not take this step, is, to my mind, a mistake, which must be attributed to his one-sidedness, which, in turn, results from the fact that he generalizes too arbitrarily his observations on butterflies and the conclusions which he draws from them. Animals and plants certainly possess many characteristics which cannot be explained by means of his theory alone. The conclusion will probably be finally arrived at, that nature is inexhaustible and many-sided, even in the lines on which it proceeds to attain this or that end.

One thing, however, of primary importance is evident from the investigations of Eimer, namely the proof that the same lines of development may be entered upon from entirely different starting-points, and that the number of

these lines is limited. This fact is of importance because it enjoins more caution in arguing from uniformity of development to family-relation, than has been usually employed since the days of Darwin. The method commonly employed is undoubtedly very convenient, but is somewhat liable to be misleading. Hence, if one wishes to establish the genealogical relationship of forms, nothing remains but to set out on the laborious path of studying the development of both; and even then it remains questionable whether the truth will be arrived at. However, he who concludes to relationship from a comparison of developed forms, is much less likely to arrive at the truth.

In one point Eimer concedes too much to Darwinism, in the matter of the famous fundamental principle of biogenesis, according to which an organism is said to repeat in its individual development the whole series of its progenitors. Although he does not enter upon a discussion of the principle, it is evident from one passage that he accepts it. One is inclined to think that his careful observations and experiments should have convinced him of the contrary. It appears to me, at least, that the abundant materials of his observations bear evidence radically opposed to the principle. During late years, the antagonism to it has been on the increase, and the day is not very distant when it shall have passed into history. It would certainly be a laudable undertaking to enter upon a thorough investigation of the actual basis of the principle.

CHAPTER VI.

In every disease, especially in a lingering one, there are times when life's flickering embers glow with an unnatural brightness. Hence, it would not be at all surprising if a similar phenomenon were to be observed in the case of dying Darwinism; for it cannot be doubted that its disease is chronic. It has, in fact, been dying this long time. Certain indications render it very probable that we are at present witnessing such a phenomenon, for to-day we behold once more a few naturalists stepping before the public in defense of Darwinism. We are desirous of presenting the present status of the Darwinian theory as objectively as possible, hence, since we have hitherto heard exclusively anti-Darwinian testimonies—as the nature of the case demanded—we shall now lend our attention to a Darwinian. The reader may then decide for himself whether this treatise should not still bear the title, "At the Death-bed of Darwinism."

The naturalist in question is the zoologist, Professor F. von Wagner. In the "Umschau" (No. 2, 1900) he published an article, "Regarding the Present Status of Darwinism," which is highly instructive and important in more respects than one.

We wish, in the first place, to call special attention to the following statements embodied in the article: "It is

not to be denied that in serious professional circles the former enthusiasm has considerably decreased and a scepticism is gaining ground more and more, which betrays a widespread tendency towards revolutionizing current theories. The *fin de siecle* therefore, finds Darwinism not with the proud mien of a conqueror, but on the defensive against new antagonists." And again: "It seems, in fact, as if Darwinism were about to enter a crisis, the outcome of which can scarcely be any longer a matter of doubt."

To what outcome reference is made, appears from two sentences in the Introduction: "Thus it happens that a theory which was once accorded enthusiastic approval, is treated with cold disdain or vice versa. Examples of this are to be found in the history of all sciences and circumstances seem to indicate that Darwinism is to add another to the number of these theories."

Is not this exactly what we have repeatedly asserted? It is most significant that these words are not written by an opponent of Darwinism, but by one who seems to be thoroughly convinced of the truth of Darwinism. I am of opinion that it can be no longer a matter of doubt to any one, that the position of Darwinism is hopeless. If this were not true, a Darwinian would be very careful about making such an open and unreserved statement.

We therefore accept Professor von Wagner's words as a very welcome endorsement of what we have constantly maintained. Professor von Wagner, however, proposes to himself the further question: Whence comes the unfavor-

able attitude of present-day natural science towards Darwinism? A discussion of this question by a Darwinian cannot but be of interest to us, and indeed is an important contribution to the problem. With Goette, Professor von Wagner admits that the objections, which are raised against Darwinism to-day, are the very same which were raised from thirty to forty years ago. But when he then proceeds to assert that this is not to be explained on the assumption that the pristine enthusiasm for selection was due to a serious over-estimation of that theory, he fails to furnish even a shred of evidence in support of his assertion.

Anyone can readily point out that Darwinism explains the totality of the world of organisms by interlinking them, but has generally failed to account for the individual case, Wagner admits this as far as the "actual" is concerned, for it is quite impossible to trace with any certainty the action, in any particular case, of natural selection in the process which results in the production of a new species. At the outset it was reasonable to hope, that with the progress of science this difficulty would be solved or at least lessened; but this expectation has not been realized. * * *" It is wholly unintelligible how a naturalist can make this statement five hundred years after Bacon of Verulam, without drawing therefrom the proper conclusion. This lack of logic reminds me strongly of the assertion recently made by an eminent authority, that the principal cause of the difficulties of many naturalists in matters of religion is their deficient philosophical training.

Wagner's statement implies that, in the case of Darwinism one may in defiance of all established law, actually reverse the methods of natural science. How justifiable and how necessary was it not, then, that even three decades ago Wigand should have written his comprehensive work: "Darwinism and the Scientific Researches of Newton and Cuvier."

Ordinarily the scientific (inductive) method proceeds from the "actual" and attempts to deduce from the "individual case" an explanation, which applies to the whole. Here, however, we are face to face with a theory, which, according to the candid confession of an advocate, fails in the individual case, but furnishes a unifying explanation of the whole. This means nothing less than a complete subversion of all scientific methods. Usually a theory is deduced from separate observations regarding the "actual" but here—and this is what Wigand constantly asserted—the theory was enunciated first, and then followed the attempt to establish it in fact. One could then rest content and trust to the future to establish the theory by producing evidences of the "actual" in the individual case. But forty years have elapsed since the Darwinian hypothesis first became known, naturalists by the thousands have spent themselves in the endeavor to corroborate it by proofs based on actual facts, and to-day one of its own advocates has to confess that the endeavor has been a total failure. Instead of drawing the conclusion, however, that the theory is unwarranted and that the decrease of enthusiasm for it is

therefore a natural consequence, he gratuitously enters a flat denial of this inference.

Every intelligent observer must conclude with absolute certainty from this confession of a Darwinian, that Darwinism is, in fact, not a scientific but a philosophic theory of nature.

But let us proceed to a consideration of the other reasons which Wagner suggests as an explanation of the retrogression of Darwinism. He states as a first reason, that scientific research since Darwin "has amassed such an abundance of empiric materials for the truth of the principle of Descent, that this doctrine has been able, even for some time past, to maintain an independent position and to draw proofs of its truth immediately from nature itself, without the intervention of Darwinism." * * * "From which it follows as a matter of course, that the question, whether the manner indicated by Darwin for the origin of species is the correct one, has decreased by no means inconsiderably in significance, inasmuch as Darwin's theory could now, if it were necessary, be abandoned with less concern than formerly because it could be relinquished without detriment to the doctrine of Descent."

It is unintelligible how one can attempt to explain a fact of such importance so superficially. With naive unconcern there appears on the face of it the acknowledgemen that Darwinism has really not been based on actual observation but has been enunciated for the sake of the doctrine of Descent. Come what may, this must be vindi-

cated. Other means are now said to substantiate it, hence the Darwinian crutches may safely be discarded. The principle of action twenty or thirty years ago was therefore: a poor explanation is better than no explanation. I cannot understand, how Wagner dares to credit present-day naturalists with such motives.

When he then proceeds to say "that with the advance of the principle of development, new lines were entered upon, which led primarily to the corroboration and empiric demonstration of the doctrine of Descent, and not of Darwinism"—that the theory of Darwin was consequently neglected and, in fact, forced into the background—"that the labors specifically attributable to Darwinism as compared with the theory of Descent, put the former more and more into a false position to the detriment of its prestige"—when, I say, Wagner has marshalled all these considerations to explain the present aversion to Darwinism, he is guilty of a total subversion of facts. The true state of the case is the very contrary.

The credit given by Wagner to the Darwinian theory for stimulating research, is the very same as I also accorded it. The purpose of this research undoubtedly was to substantiate not only the doctrine of evolution in general, but also the Darwinian hypothesis in particular. To verify this, one need only glance over the various numbers of the "Kosmos," the periodical, which Haeckel and his associates established for that very purpose and which continued to publish good and bad indiscriminately until

some time in the eighties when lack of interest compelled its discontinuance. Wagner therefore misconstrues facts when he asserts that there have been no specifically Darwinian researches. Since the thoughts of Darwin first found expression these researches have been most abundant and their results have been consigned to the printer's ink. No doubt—and this is the salient point, which Wagner passes over in complete silence—they have been of service only to the doctrine of Descent in general, and in spite of the energetic efforts of the Darwinians, they have never led to the ardently desired proof from facts of the hypothesis of selection. This and no other is the state of the case.

In view of these vain endeavors, however, intelligent investigators have gradually become perplexed and have turned away from Darwinism, not because they have lost interest in it nor even because they no longer feel the need of it to assist the doctrine of Descent, but for the one sole reason that its insufficiency has become more and more apparent and that all experiments undertaken on its behalf have made the fact clearer and clearer that the first criticism of the great naturalists of the sixties and seventies was perfectly justified.

In forming a judgment concerning the whole question it cannot but be a matter of the utmost significance, that men have turned away from Darwinism to entirely different theories of Descent. It is a mistake to suppose, as Wagner would have us suppose, that the last decades have produced nothing but generalities regarding the doctrine of

Descent. For they have also witnessed the publication of a number of significant works, which aimed at giving a better individual explanation than was found in Darwinism. I need but recall Naegeli, Eimer, Haacke and a host of others. The most noteworthy feature of these new views regarding theories of Descent, is the constantly spreading conviction that the real determining causes of evolution are to be sought for in the constitution of the organisms themselves, hence in internal principles. This view, however, is not only absolutely and diametrically opposed to Darwinism but completely destructive of it as well.

The actual circumstances, therefore, are the very reverse of those pictured by Wagner. Darwinism has been rejected not on account of a lack of research but on account of an abundance of research, which proved its absolute insufficiency.

Besides these "general points of view," as he calls them, Wagner finds two other "considerations of no less importance" for explaining the decay of Darwinism. It is an incontrovertible fact, that the hereditary transmission of acquired characters has in no way been proved. On the contrary after it had at first received a general tacit recognition and was postulated by Lamarck, Darwin and Haeckel, it was denied by Weismann. Wagner asserts "that the number of those who have allied themselves with Weismann in this matter is obviously on the increase as is naturally the case, since, to the present day not a single incontestable case of hereditary transmission of acquired

characters has been demonstrated, where as actual facts are at hand to prove the contrary."

It is perfectly evident that the doctrine that acquired characters are not inherted is fatal to Darwinism. Hence Wagner rightly considers its ascendancy a notable factor in bringing about the decay of Darwinism.

Finally, Wagner briefly indicates that certain new theories necessarily exercised an influence on Darwinism. Haeckel and the palaeontologists of North America supplemented it with a number of Lamarckian elements without alteration of its essential principles (the Neo-Lamarckians); Eimer regards the transmission of acquired characters as an established fact, but rejects natural selection as wholly worthless; Weismann, on the contrary, denies the transmission of acquired characters, but nevertheless regards natural selection as the main factor in the formation of species (the theory of the Neo-Darwinians). Eimer speaks of the impotence of natural selection, Weismann of its omnipotence. All this has shaken men's confidence in the trustworthiness of the Darwinian principles. This fact we are in no way inclined to doubt, but we must again differ from Wagner with regard to its significance. We maintain that matters had to take this turn, since the reason why Darwinism is now meeting with such serious opposition, is to be found in its very nature. This indeed should have been recognized forty years ago instead of just beginning to dawn on men of science at the present day. For if acquired characters are not transmitted by

heredity, Darwinism is an impossibility. Forty years ago Darwinism should have recognized that its first and supreme task was to prove the hereditary transmission of acquired characters, so as to establish itself, first of all, on a sound footing.

One of the most peculiar incidents in this scientific tragi-comedy is the fact that Weismann, the mainstay of contemporary decadent Darwinism, attacks with might and main its fundamental assumption, the transmission of acquired characters, whereas Eimer, who is thoroughly convinced that he has proved that doctrine, in his turn attacks Darwinism and proves with telling effect the impotence of its principles. The amused observer can really demand nothing more. He can but rub his hands for joy and cheer on the heated combatants: Well done! On with the struggle! and the last vestige of Darwinism will soon have disappeared.

If, then, we were to summarize our strictures on the reasons which Wagner adduces to account for the decay of Darwinism, we would say this: Some of them are unwarranted, others are falsely interpreted.

There is, however, a third point which is of special interest to us, in the article under consideration; we refer to the view, which there finds expression, regarding the nature and outcome of the present crisis—a crisis, which, as a candid naturalist, Wagner is not in a position to deny.

This view rests on the entirely gratuitous assertion, "that the decline, in the esteem enjoyed by Darwinism, is

not due to a better insight arising from widened experience, but is primarily the expression of a tendency—a tendency which resulted almost as a psychological necessity from the precarious position into which Darwinism was forced under the sway of the theory of Descent." This assertion rests, as stated above, on wholly erroneous assumptions. It is a serious mistake, to speak in this connection of tendencies and even to brand them as a "psychological necessity." The decline in esteem is essentially due to experience, and indeed to experience which has made it certain that Darwinism has everywhere failed.

The importance of the present crisis in Darwinism is to be restricted even further, according to Wagner, by the fact, "that the real objections, urged against the theory of Darwin, are almost in every instance based on theoretic considerations, the validity of which can be put to the test only in fictitious cases. This manner of proceeding manifestly leads to the inevitable consequence, that the results thus obtained can claim no decisive weight against Darwinism. A decisive critique can be constructed only on the basis of experience, and in this connection it cannot be emphasized sufficiently, that, as yet, the path to it has been scarcely indicated, to say nothing of its having been actually pursued." The reason for this fact according to Wagner, is to be found "in the numerous and most extraordinary difficulties that arise in the way of the empiric investigation of the theory of selection."

After we have read all this, we instinctively ask our-

selves: do we actually live at the beginning of the 20th century? Is it possible, that even at this late day the whole structure of scientific method is to be subverted in this fashion?

Just consider for a moment, what according to these words is the actual import of the whole article: Darwinism is a unifying explanation of the origin of the totality of the world of organisms, but fails in the individual case; in any specfied case it is "almost impossible" to trace with any certainty the action of natural selection in the process which results in the production of a new species; that is, Darwinism was enunciated with a complete disregard for inductive method, as an hypothesis to explain the whole, and without actual proof in the concrete—a most unscientific procedure. Immediately after, however, the adversaries of Darwinism are asked in all seriousness to produce individual facts in disproof of the theory.

In the same strain Wagner goes on to say that "from no point of view is our vision so penetrating as to be able to grasp the coherence which according to Darwin pervades the complex course of natural selection. When men of science take occasion to repudiate Darwinism because of our inability to explain satisfactorily any particular case by means of the theory of selection, this inability arises not from the theory of Darwin but from the inadequacy of our experience. For as yet the empiric prerequisites for an objective judgment regarding the validity or futility of the theory of selection are entirely lacking."

Every naturalist who believes in the inductive method must needs draw the conclusion from these naive admissions, that, as Darwinism lacks the empiric prerequisites, it should be discarded. Moreover, the demand is made in all seriousness, that, in order to refute Darwinism which has not as yet been established empirically, empiric proofs should be forthcoming.

To my mind, the scientific and logical bankruptcy of Darwinism was never announced more bluntly and ingenuously. Furthermore it must be remarked that Wagner's statement, regarding "fictitious cases," is not even pertinent. He seems to have no idea of the observations and experiments of Sachs, Haberlandt, Eimer, and a host of other investigators. The disproof of Darwinism on the basis of scientific research is an accomplished fact.

A word about the conclusion of Wagner's article, which in view of what has been already said, cannot be a matter of surprise. He maintains that the considerations which he adduces, "clearly" prove that there is no "reasonable ground for despairing of the theory of Darwin —; for a theory, which neither proceeds from questionable assumptions, nor loses itself in airy hypotheses, but rests throughout and exclusively on facts, need never fear the advance of science."

But a moment ago it was asserted that the theory of selection is lacking "entirely as yet the empiric prerequisites" and now only twenty-three lines further on, it rests "throughout and exclusively on facts." It is difficult to

know what conclusion to come to regarding a naturalist and University professor who can commit himself to such a contradiction. I shall abstain from any comment and let the reader form his own judgment.

Does this article betoken the death-bed of Darwinism? For my own part I repeat what I said above, that I consider it the most valuable contribution to the characterization of decadent Darwinism that has appeared up to the present time. The sooner a theory, which is thus treated and characterized by one of its own advocates, is stored away in the lumber-room of science, the better. In view of the sound judgment, which is to-day becoming more and more apparent in scientific circles, there is reason to hope that this article of Professor von Wagner will be additional incentive for many naturalists to break completely with Darwinism.

CHAPTER VII.

In the year 1899 Haeckel published a new work, which he intended as a kind of testament; for with the close of the nineteenth century the author desired to put a finishing touch to his life-work.

In the Preface Haeckel states with very remarkable modesty that his book cannot reasonably claim to present a complete solution of the riddles of existence; that his answer to the great questions can naturally be only subjective and only partly correct; that his attainments in the different branches is very unequal and imperfect; and that his book is really only a sketch book of studies of very unequal value. In this way the author naturally gains at once the confidence of his reader who is thus prepared to yield assent when the author makes pretense to sincerity of conviction and an honest search after truth. The reader's surprise at the contents of the book and at the manner of its presentation is, however, only increased by this ruse. All modesty has vanished, monistic doctrines are presented as absolute truth, every divergent opinion is contemptuously branded as heretical; in short, the book reveals a Darwinian orthodoxy of the purest type, with all the signs of blind bigotry and odious intolerance which the author imagines he discovers in his Christian adversaries. It is difficult to see where, in view of such a contradiction be-

tween the work and its Preface, there is room for an honest striving after truth. Personally I do not wish to deny Haeckel all honesty of purpose, for it is my endeavor to understand the *whole* man. The one prominent feature of the "Weltraetsel" is the fact that, owing to a very marked deficiency in philosophical training, Haeckel has become so completely absorbed in his system that he has lost all interest in everything else and takes cognizance only of what suits his purpose. What he lacks above all, is the ability to appreciate even the "honest" opinion of others; hence, from the very outset he brings into the discussion that bitterness of which he complains in others (in the Weltraetsel he once makes this accusation against me). Notwithstanding all this, honest conviction may be present, but if so, it is joined with total blindness. But what is to be thought of his search after truth since he completely ignores his adversaries? For instance, in spite of Loofs' attacks, he continues to have his book reprinted without alteration, without submitting it to revision. The "Reichsbote" is perfectly in the right when it says: Haeckel, in fact, takes account only of what suits his purpose.

As regards the contents of the "Weltraetsel," it is not my intention to enter here upon a criticism of it but merely to discuss it as illustrating the general status of the theory of Descent. It is to be noted, in the first place, that it is really not a scientific book at all; for of its 472 pages, the first or "Anthropological Part," with which alone we are

here concerned, occupies only 74 (from pages 27 to 100), even less than one-sixth of the whole, whereas the "Theological Part" is almost twice as long. The book is, in fact, rather a theologico-natural-philosophical treatise than a work of natural science. The scientific part is, however, the foundation on which Haeckel builds up his natural philosophy, and which he uses as the starting point of his criticism of theology. Hence it is worth our while to discuss it.

How then fares it with the anthropological basis of Haeckel's whole system? As an attentive student of his age the naturalist-philosopher of Jena must have perceived the true position of Darwinism, namely, that the foremost naturalists of to-day have no more than an historical interest in it. Since, in accordance with the well known tendency of old men to persevere in the position they have once assumed and not easily to accept innovations, Haeckel is still an incorrigibly orthodox Darwinian, we should naturally expect him to embody in this testament some new cogent evidence of the truth of Darwinism. But nothing of that nature is to be found in the book.

The first chapter of the "Anthropological part" is taken up with a "general history of nineteenth century culture," in itself a sign of peculiar logical acumen, that he should include this and the "struggle regarding world-views" in the "anthropological part" instead of embodying it in a general introduction. The remaining chapters treat: "Our Bodily Structure," "Our Life," "Our Embryonic-history," "Our Family-history." It is not to be supposed,

however, that any arguments are here adduced, nothing but assertions; a large part of the chapter is taken up with historical sketches, in which Haeckel again proves himself utterly devoid of all appreciation of history and all sense of justice. He attributes the decay of the natural sciences to the "flourishing condition of Christianity" and dares to speak of the unfavorable influence of Christianity on civilization. Apart from the historical sketch, each chapter presents only the quintessence of Darwinism, fairly bristling with assertions, which are boldly put forth as incontrovertible truths. In view of the author's demand to have at least his sincere love of truth recognized, we can but throw up our hands out of sheer astonishment. To illustrate Haeckel's "love of truth" let it suffice to observe that in the second chapter he asserts that man is not only a true vertebrate, a true mammal, etc.—which indeed is passable—but even a true ape (having "all the anatomical characteristics of true apes"). With a wonderful elasticity he passes over the differences. What, indeed, is to be said, when he states as a "fact" that "physiologically compared (!), the sound-speech of apes is the preparatory stage to articulate human speech." It is so simply monstrous, that even Garner's famous book of ape-speech, cannot surpass it. As a third illustration of Haeckel's method of argumentation, if we are still justified in speaking of such a thing, we may mention his assertion (p. 97) as a "certain historical fact," "That man is descended directly from the ape, and indirectly from a long line of lower vertebrates." If, in

view of the results of research during the last forty years any one can assert this as a "certain historical fact" and can still wish to be credited with honest conviction and love of truth, there remains, to adopt Haeckel's own expression, but one explanation for this psychological enigma, namely, intellectual *marasmus senilis*, which may very easily have set in with a man of sixty-six, who himself complains (p. 7) of "divers warnings of approaching age."

Thus, the anthropological part of the "Weltraetsel" contains nothing new; always the same old story, the same threadbare assertions without a shred of evidence to corroborate them.

The remaining parts also contain various scientific assertions, which are proposed as facts without being such, but these parts do not immediately pertain to our theme. Suffice it to say that, after reading Haeckel's "Weltraetsel," one would be led to think that there is no question of a "deathbed of Darwinism," but that on the contrary Darwinism, as remodeled by Haeckel, is more in the ascendant to-day than ever. Let us judge of its prestige by the reception accorded the "Weltraetsel."

One unaltered edition after the other, thousand after thousand, the book is given to the public. Hence it must meet with approval. It does indeed meet with approval, but the question is, from whom? Immature college and university students will doubtless receive it with reverential awe, just as they received the "Natural History of Creation" twenty-five years ago. Bebel accepts the book

as an infallible source of truth, and after him the social democrats and free-church members will add it to the list of their "body and stomach books," which alone will afford it a respectable clientele, at least in number. In no one of my "deathbed articles," however, have I as yet ever maintained that Darwinism was decadent in *these* circles. I know full well, that Darwinism has filtered down into that sphere and there satisfies the anti-Christian and anti-religious demands of thousands.

Nothing, however, really depends on these senseless blind adherents of Haeckel's unproved assertions. We are now intent upon investigating how the world of eminent thinkers and natural science regards the latest product of Haeckel's fancy. That alone is of importance in ascertaining the real status of Darwinism.

As regards, in the first place, the other parts of the book, it is well known that all of them were vigorously attacked. Loofs in particular exposed Haeckel's theology, according to its deserts, in the clear light of truth, and convicted Haeckel of "ignorance" and "dishonesty;" while the philosopher Paulsen made short work of the "Weltraetsel" from his own standpoint, ("if a book could drip with superficiality, I should predicate that of the 19th chapter"). Harnack also condemned the theological section in the "Christliche Welt," and Troeltsch, Hoenigswald, and Hohlfeld took Haeckel severely to task on philosophic grounds. The naturalists have thus far maintained silence.

Scientific journals, and, I believe, only the more pop-

ular ones, pass a varying judgment on the book according to the intellectual bent of their book reviewers; but no one of the eminent and leading naturalists has publicly expressed his opinion regarding it. They all maintain a very significant silence, which speaks for itself. Now, however, just at the proper time a book, *Die Descendenz-theorie* has appeared from the pen of the zoologist, Professor Fleischmann of Erlangen, in which Haeckel is severely condemned. (See Chapter IX.)

The press-notices of the Weltraetsel, which are quoted in the book will be considered presently. It appears that with reference to natural science, only "laymen" discuss the book and approve of Haeckel's views. This is a point of great importance since it proves satisfactorily that men of science will have nothing to do with the "Weltraetsel." The large number of replies would, however, not allow Haeckel's friends to remain silent. The most extensive defense forthcoming was a pamphlet published by a certain Heinrich Schmidt of Jena. It cannot be gathered from his book (Der Kampf um die Weltraetsel, Bonn, E. Strauss 1900) to what profession the author belongs, hence I am unable to judge whence he derives the right to treat Haeckel's opponents in summary a manner. It is significant to note what class of men, according to Schmidt, received the "Weltraetsel" with enthusiasm and joy. They are August Specht, the free-church editor of "Menschentum" and of the "Freien Glocken," Julius Hart, Professor Keller-Zuerich, the philosopher and "Neokantian" Professor Spitzer of Graz, the popular literateur W. Boelsche,

W. Ule, and a few unknown great men, Dr. Zimmer, Th. Pappstein, R. Steiner, A. Haese; but stay, I came very near forgetting the great pillar, Dodel of Zuerich. But where is there mention of the professional colleagues of Haeckel whose testimonies could be taken seriously? Under the heading "Literary Humbug," which evidently has reference to the contents of his own work, Schmidt then meets numerous objections. Here vigorous epithets are bandied about, as, for instance, "absolute nonsense," "muddler," "foolish and senseless prattle," "idle talk," etc.; and from Dodel he copies the words with which the latter once sought to annihilate me: Job, verse 10, "Thou hast spoken like one of the foolish women." And he ventures to express indignation at Loofs' "invectives." As a compliment to Lasson he declares that he could easily conceive of the possibility of an ape ascending the professor's chair and speaking as intelligently as he (Lasson); which remark he probably intended as a witticism. He informs his readers that the criticism of Haeckel by men like Virchow, His, Semper, Haacke, Baer, and Wigand have been examined by professional specialists and proved practically worthless. This statement alone so clearly reveals Schmidt's lack of critical facultly and judgment that by it he at once forfeits his right to be taken seriously.

The whole book is nothing more than a collection of quotations from the reviews of the "Weltraetsel," interspersed with characteristic expressions like "idle talk," "nonsense," etc., as exemplified above. A really pertinent reply and refutation of objections is entirely beyond

Schmidt's range; he waives the demand for a direct reply, for instance, in the following amusing way (p. 28): "Two reasons, however, prevent me from being more explicit: In the first place I do not like to dispute with people who adduce variant readings and church-fathers as proofs and can still remain serious. In the second place I would not like to fall into the hands of a Loofs." In this manner it is indeed easy to evade an argument, which for good reasons one is not able to pursue. Loofs' criticism is so serious and destructive that it should be of the utmost concern to Haeckel's friends to refute it. Since they are unable to do so, they content themselves with references to Loofs' caustic style, which he should indeed have avoided. There are, nevertheless, cases in which one must employ trenchant phraseology, and Haeckel himself has given an occasion for it; a dignified style is simply out of the question in his case. Haeckel extricated himself with even greater ease, by declaring that he had "neither time nor inclination" for reply, and that a mutual understanding with Loofs was impossible because their scientific views were entirely different. Could anything be more suggestive of the words of Mephistopheles:

> "But in each word must be a thought—
> There is,— or we may so assume,—
> Not always found, nor always sought,
> While words—mere words supply its room.
> Words answer wel l, when men enlist 'em,
> In building up a favorite system."

There are two other points in Schmidt's book that are of interest to us. The first of these is the manner in which

the author treats the Romanes incident. Romanes ranks, as is well known, among the first of Haeckel's authorities. Hence it is a very painful fact that, but a short time before the publication of the first edition of the "Weltraetsel," my translation into German of Romanes' "Thoughts on Religion" should have appeared. From this book it was evident that Haeckel and his associates could no longer count this man among their number since he—a life-long seeker after truth—had abandoned atheism for theism, and died a believing Christian. Troeltsch and the "Reichsbote" asked whether Haeckel had purposely concealed this fact, and Schmidt now explains that Haeckel first became acquainted with the "Thoughts on Religion" through him towards the end of January, 1900. Unfortunately he does not add that since then a number of new editions of the "Weltraetsel" have appeared, in which Haeckel could have explained himself in an honorable manner. Schmidt has therefore not been successful in his attempt to clear up this matter.

But how does he settle with Romanes? He says: "*We are assured* that the thoughts were written down by the English naturalist George John Romanes"; and again: "The thoughts are published by a Canon of Westminster, Charles Gore, to whom *they are said* to have been handed over after the death of Romanes in the year 1894." Then he has the audacity to place Romanes in quotation marks. And finally he asserts that they would abide by Romanes' former works as their authority, the more so, because these were not, like the "Thoughts," "published and glossed by a Canon only after his (Romanes') death." By

means of all this and of a comparison with the "Letters of the Obscurantists" he wishes to create the suspicion that there might be question here of forgery. Such an insinuation, (I employ Schmidt's own words) "cannot be characterized otherwise than as contemptible." "Here it is even worse than contemptible." I must beg my reader's pardon for overstepping the bounds of reserve with these caustic words, although they originated with Schmidt; but really the flush of anger rightfully mounts to one's cheeks when a man, from the mere fact that he is a disciple of the "great" Haeckel assumes the right to charge Canon Gore and indirectly myself with forgery. It is really very significant that these men should have to resort to such base and despicable expedients to extricate themselves from their unpleasant predicament. Apart from this, it was very amusing to me personally to think that for the sake of my unworthy self, Schmidt should have borrowed from his lord and master the epithet "pious," which Haeckel in his turn has drawn from his cherished friend Dodel. In all probability they will continue to hawk it about in order to bring me into disrepute with the rest of their kind. The few remarks Schmidt still finds it proper to make regarding the "Thoughts," betray his inability to understand the book. But as I stated in the preface it was a difficult book to read and understand. It is obviously not reading matter for shallow minds. I refer Schmidt to the biography of Romanes, published by his wife, (The Life and Letters of G. J. Romanes, London, Longmans, Green & Co., 1898), where he will find Romanes' religious development described by a

well-informed hand. This development began as early as 1878, hence during the time of his intimate friendship with Darwin. In this book on pages 372 and 378 Schmidt will also find the words in which, *before* his death, Romanes begged that, if he were personally unable to publish the "Thoughts," they should be given to his friend Canon Gore after his own death. But why waste so many words on Mr. Schmidt, for since all these things must be doubly disagreeable and painful to him and Haeckel, he will very probably resort without delay to personal insinuation and accuse Mrs. Romanes of forgery.

To us, however, who thoroughly appreciate the situation, it is a matter of great moment that of one of the few really eminent naturalists, to whom Haeckel thought to be able to lay full and exclusive claim, for the last twenty years of his life should have been moving towards the Christian faith in his eager search for truth and should die not a monist, but a convinced Christian. Neither did he die an old man, to whom the adherents of monism would certainly have the effrontery to impute feeble-mindedness, but at the early age of forty-six years. Nor was his a sudden deathbed conversion—an impression which Schmidt attempts to create (p. 62) in order to be able with H. Heine to relegate the conversion to the domain of pathology—but followed after many years of diligent and honest study and research. The other point of which we must treat here, is the manner in which, after the example of Dr. Reh, Schmidt attempts in the "Umschau" to exonerate Haeckel in the

matter of the "History of the three cliches." To begin with, it is at the very least dishonest on the part of Schmidt to say that, "in default of scientific arguments, theological adversaries have for the last thirty years been using it as the basis of their attacks." That is untrue, the "theological adversaries" have not had knowledge of it for that length of time. On the contrary Haeckel's own scientific colleagues were the first to discover and publish the matter some time in the seventies, and in consequence excluded Haeckel from their circle. Why does Schmidt not mention here the names of Ruetimeyer, His, and Semper? Furthermore Schmidt writes as if Haeckel had satisfied his colleagues in the matter of his forgery by declaring soon after (1870) that he had been "guilty of a very ill-considered act of folly." Why does Schmidt not mention the fact that the weighty attacks of His (Our Bodily Form and the Physiological Problem of its Origin, Leipzig, 1875) dates from the year 1875, five years after Haeckel's forced, palliative explanation? Besides, this incident of the three cliches is only one instance; the other examples of Haeckel's sense of truthfulness are for the most part entirely unknown to his "theological adversaries," who have nowhere to my knowledge made use of them; but *all* of them have been brought to light and held up before Haeckel by naturalists, namely, by Bastian (1874), Semper and Kossmann (1876 and 1877), Hensen and Brandt (1891), and Hamann (1893). Does this in any way tend to establish Schmidt's honesty? (Dr. Dennert has entered into a more searching

criticism of Haeckel in his book, *Die Wahrheit ueber Haeckel.* 2 Aufl Halle a. S., 1902.)

In a word, the manner in which the "Weltraetsel" was received and in which Haeckel has been defended by Schmidt, are valuable indications of the decay of Darwinism. I repeat that I am speaking of course of the leading scientific circles. Those who hold back are never lacking, and one cannot be surprised that, in the case of Darwinism, their number is considerable; for on the one hand, to understand it an extraordinarily slight demand is made on one's mental capacity; and on the other hand it is a very convenient and even a seemingly scientific means of obviating the necessity of belief in God. These facts appeal very strongly to the multitude.

In concluding this section, we shall quote a positive testimony to the decay of Darwinism. On page 3 of his "Outlines of the History of the Development of Man and of the Mammals" (Leipzig, W. Engelmann, 1897) Prof. O. Schultze, Anatomist in Wuerzburg, says: "The idea entertained by Darwin, that the development of species may be explained by a natural choice—Selection—which operates through the struggle of individuals for existence, cannot permanently satisfy the spirit of inquiry. Even the factors of variability, heredity, and adaptation, which are essential to the transformation of species, do not offer an exact explanation."

CHAPTER VIII.

I have already called attention several times to the fact that Darwinism is indeed on the wane among men of science, but that it has gradually penetrated into lay circles where it is now posing as irrefragable truth. Especially the circles dominated by the social democrats swear by nothing higher than Darwin and Haeckel. In fact, only a short time ago Bebel publicly professed himself a convert to Haeckel's wisdom.

It is inevitable, however, that light should gradually dawn even in these circles, for it would be indeed strange, if no honest man could be found to tell them the truth regarding Darwinism. This has occurred sooner than I dared to hope. This chapter can announce the glad tidings that even in "social-democratic science" Darwinism is doomed to decay. Much printer's ink will, of course, be yet wasted before it will be so entirely dead as to be no longer available as a weapon against Christianity; but a beginning at least has been made.

In the December number of the ninth year of the *Sozialistische Monatshefte*, a social-democratic writer, Curt Grottewitz, undertakes to bring out an article on "Darwinian Myths." It is stated there that Darwin had a few eminent followers, but that the educated world took no notice of their work; that now, how-

ever, they seemed to be attracting more attention. "There is no doubt, that a number of Darwinian views, which are still prevalent to-day, have sunk to the level of untenable myths. True, the main doctrine of Darwin—the origin of new species from existing ones—is incontestably established, but apart from this even some very fundamental principles, which the master thought he discerned in the development of organisms, can scarcely be any longer maintained."

It may be well to remark here, that this was not really Darwin's main doctrine, for it already existed before his time (Lamarck, Geoffroy St. Hilaire). Darwin's main doctrine is the explanation of the origin of species by natural selection operating through the struggle for existence. It is therefore the old error repeated: Darwinism is confounded with the doctrine of Descent, of which it is merely one form. It is not our intention to derogate in the least from Darwin's merit, which consists in the fact that he gained general recognition for the doctrine of Descent; but that was not his main work. He wished above all to explain the *How* of Descent; this is his doctrine, and this doctrine we attack and declare to be on the point of expiring.

Grottewitz very frankly continues: "The difficulty with the Darwinian doctrines consists in the fact that they are incapable of being strictly and irrefutably demonstrated. The origin of one species from another, the conservation of useful forms, the existence of countless intermediary links,

are all assumptions, which could never be supported by concrete cases found in actual experience." Some are said to be well established indirectly by proofs drawn from probabilities, while others are proved to be absolutely untenable. Among the latter Grottewitz includes "sexual selection," which is indeed a monstrous figment of the imagination. There was moreover really no reason for adhering to it so long. It is eminently untrue, that the biological research of the last few years proved for the *first* time the untenableness of this doctrine, as Grottewitz seems to think. Clear thinkers recognized its untenableness long ago, and surely Grottewitz and the whole band of Darwinian devotees as well, could have known that as early as twenty-five years ago this doctrine had been subjected to a reductio ad absurdum with classic clearness in Wigand's great work.

It is certainly a very peculiar phenomenon; for decades we behold a doctrine reverently re-echoed; thoughtful investigators expose its folly, but still the worship continues, the Zeitgeist must have its idol. It appears, however, as if the Zeitgeist were gradually tiring of its golden calf and were on the point of casting it into the rubbish-heap. Misgivings arise on all sides; here one class of objections are considered, there another. A closer examination reveals that these are by no means new reasons, based on new researches, but the very oldest, urged long ago and perhaps much more clearly and forcibly. At that time, however, the Zeitgeist was under the spell of the suggestion of individual men: it heard and saw nothing but the captivating,

obvious simplicity of the doctrine; but now when the subject begins to be tedious and the discussion lags, the interest consequently abates and the Zeitgeist suddenly grasps the old objections, presented in a new garb, and what was hitherto truth, clear and irrefutable, now sinks into the dreary, gray mists of myth. Sic transit gloria mundi!

This has been the history of Darwinism, and especially of Darwin's theory of sexual selection. What Grottewitz urges against it, was advanced decades ago by other and more eminent men; then people would not listen, to-day they are inclined to listen. Of very special interest is the further admission, that "the principle of gradual development" has been "considerably shaken" and is "certainly untenable." Grottewitz points out that it has been demonstrated that the progeny of the same parents are often entirely dissimilar, and that new organs very suddenly spring up in individuals even when they had had no previous existence. "A slight variation from the parent form is of no utility to the progeny; they must acquire at once a completely developed, new character, if it is to be of any use to them." Quite right! but this one admission is destructive of the entire doctrine of natural selection. If one accepts saltatory evolution, as for instance, Heer, Koelliker, and Wigand did long ago, then, as Grottewitz now discovers, the difficulty arising for Darwinism from the absence of the numerous intermediary forms which it postulates, naturally disappears.

Grottewitz attributes sudden variation to the influence of environment, just as Geoffroy St. Hilaire had already

done before Darwin. He likewise repudiates Darwin's doctrine of adaptation and the theory of "chance," which is bound up with all his views. "Darwin's theory of chance seems to me to be especially deserving of rejection." The article closed with these words: "There must evidently be a very definite principle, according to which the frequent and striking development from the homogeneous to the heterogeneous, from the no-longer adapted to the readapted, proceeds. We all of us are far from considering this principle a teleological, mystical or mythical one, but for that matter, Darwin's theory of chance is nothing more than a myth."

He is most certainly in the right. To place this whole wonderful, and so minutely regulated world of organisms at the mercy of chance is utterly monstrous, and for this very reason Darwinism, which is throughout a doctrine of chance, must be rejected; it is indeed a myth. We are grateful to Grottewitz for undertaking to tear the assumed mask of science from this myth and expose it before his associates. He should, however, have done so even more vigorously and unequivocally and should have stated plainly: Darwinism is a complete failure; we believe indeed in a natural development of the organic world, but we are unable to prove it.

In the conclusion of the article quoted there is, of course, again to be found the cloven-hoof: by all means no teleological principle! But why in the world should we not accept a teleological principle, since it is clearly evident

that the whole world of life is permeated by teleology, that is, by design and finality? Why not? Forsooth, because then belief in God would again enter and create havoc in the ranks of the "brethren."

But however much men may struggle against the teleologico-theistic principle and secure themselves against it, it is all of no avail, the principle stands at the gate and clamors loudly for admission; and if Grottewitz could but bring himself to undertake a study of Wigand's masterful work, perhaps his heresy would increase and we might perhaps then find another article in the "Sozialistische Monatshefte" tending still more strongly toward the truth.

But what will Brother Bebel with his Haeckelism say to the present article?

All in all, instead of calling his article "Darwinian Myths" Grottewitz might just as well have entitled it "At the Deathbed of Darwinism." May he bring out a series of "deathbed articles" to disclose the truth regarding Darwinism to his associates.

CHAPTER IX.

Professor Fleischmann, zoologist in Erlangen, recently published a book bearing the title, "Die Descendenztheorie," in which he opposes every theory of Descent. The book is made up of lectures delivered by the author before general audiences of professional students, hence is popular in form and of very special apologetic value. Numerous excellent illustrations aid the reader in understanding the text.

One statement in the Introduction characterizes the decided position assumed by the author. He says: "After long and careful investigation I have come to the conclusion that the doctrine of Descent has not been substantiated. I go even farther and maintain that the discussion of the question does not belong to the field of the exact sciences of zoology and botany." At the outset, Fleischmann establishes the fact that in the animal kingdom there are rigidly separated types, which cannot be derived from each other, whereas the doctrine of Descent postulates "one single common model of body-structure" from which all types have been developed. Cuvier in his day, set up four such types of essentially different structure; when Darwin's work appeared two more had been added; R. Hertwig postulates even seven, Boas nine (both 1900); J. Kennel (1893) seventeen, and Fleischmann himself sixteen. In consequence the doctrine of Descent has become

more complicated since it now embraces sixteen or seventeen different problems, each of which in turn gives rise to many subordinate problems.

The discussion which the author inaugurates regarding the domain to which the question of Descent belongs, is very well-timed. He forcibly and definitely discountenances the method which transfers it to the domain of religion. The question must be decided by the naturalists themselves according to the strict inductive method; that is, the solution must be based on well ascertained facts, without resorting to conclusions deduced from general principles. "Exact research must show that living organisms actually have overstepped the bounds defining their species, and not merely that they conceivably may have done so." Hence it is absolutely necessary to procure the intermediary forms. This is the foundation on which Fleischmann builds and against which no opponent can prevail. Fleischmann first discusses the differences between the classes of vertebrates; the mammals, birds, reptiles, amphibians and fish. For if the differences of their bodily structure could be shown to be one of degree and not radical, it could be supposed that the lines of demarcation which now delimitate the larger types might some day vanish. A single illustration suffices for Fleischmann's purpose, viz., the plan of structure of the limbs of the different classes of vertebrates. The four higher classes are characterized by a common underlying plan of limb structure, whilst fish have one peculiar to themselves. On the other hand it is an inevitable postulate of the doctrine of Descent

that fish are the original progenitors of all other vertebrates. Hence the five-joint limbs of the latter must have developed from the fins of fish. This derivation was actually attempted but without success, as Fleischmann points out at considerable length. By means of citations taken from the writings of Darwinian adherents, he illustrates the confusion which even now reigns among them on this matter. The evolution of the remaining vertebrates from the fish is therefore a wholly gratuitous assumption devoid of any foundation in fact.

Fleischmann further discusses the "parade-horse" of the theory of Descent. It has been the common belief, especially fostered by Haeckel, that the history of the Descent of our present horse lies before us in its complete integrity as pictured in the drawings of Marsh. Here Fleischmann again proves at great length the insufficiency of actually available materials. Of special importance is his repeated demand that not only individual parts of the animals but the whole organism as well should be derived from the earlier forms. If, for instance, it be possible to arrange horses and their tertiary kindred in an unbroken line of descent according to the formation of their feet, whilst the other characteristics (teeth, skull-structure, etc.,) do not admit of arrangement in a corresponding series, the first line must be surrendered.

Very similar to this is the case of the "family history of birds," which as all know, has been traced back to reptiles. It is in this matter that the famous Archaeopteryx plays an important part. Unfortunately, however, grave

difficulties are again encountered in this connection. This primitive form is a real bird according to Zittel; and according to the same investigator as also according to Marsh, Dames, Vetter, Parker, Tuerbringen, Parlow and Mehnert, it is inadmissible to connect birds with a definite class of reptiles. Haeckel finds his way out of the difficulty by supplying hypothetical forms which no one has ever seen, but which his imagination has admirably depicted as transitional forms. In so doing, however, he abandons the inductive method of natural science.

It is impossible for us to treat at such length all the remaining sections of this important book. We may mention in passing that Fleischmann examines the "roots of the mammal stock," and enters upon a detailed discussion of "the origin of lung-breathing vertebrates," the "real phylo-genetic problem of the mollusks," and "the origin of the echinodermata." It is evident that he boldly takes up the most important problems connected with the theory of Descent, and does not confine himself to a one-sided discussion of individual points. As he did not fear to examine thoroughly the famous, and as it hitherto appeared, invulnerable, "parade-horse," so neither does he hesitate to demolish the other reputed proof for the doctrine of Descent, e. g., the fresh-water snail of Steinheim, the remains of which Hilzendorf and Neumayr examined and were said to have arranged in lines of descent that "would actually stagger one." It is important to call especial attention to this because the adversaries of the book ignore it. He next shows up the so-called "fundamental principle of biogene-

sis" according to which organisms are supposed to repeat during their individual development the forms of their progenitors (enunciated by Fritz Mueller and Haeckel). Fleischmann points out the exceptions which Haeckel attributes to "Cenogenesis," (that is to falsification) and shows the disagreement among contemporary naturalists regarding this fundamental principle. Even Haeckel's friend and pupil, O. Hertwig sounds the retreat.

The 15th chapter deals with the "Collapse of Haeckel's Doctrine," which is revealed in the fact that "the practical possibility of ascertaining anything regarding the primitive history of the animal kingdom is completely exhausted and the hope of so doing forever frustrated." "Instead of scientists having been able from year to year to produce an increasing abundance of proof for the correctness of the doctrine of Descent, the lack of proofs and the impossibility of procuring evidence is to-day notorious." In the last chapter Fleischmann finally attempts to prove on logical principles the untenableness of the evolutionary idea.

He starts from the fact that philosophers use the word development to designate a definite sequence of ideas, i. e., in a logical order. "Metamorphosis, says Hegel, belongs to the Idea as such since its variation alone is development. Rational speculation must get rid of such nebulous concepts as the evolution of the more highly developed animal organisms from the less developed, etc."

Naturalists use the word in a different sense. Instead of a sequence of grades of being they posit a sequence of

transformations; instead of a logical sequence of ideas they posit a transforming and progressive development. Zoology constructs a system of specific and generic concepts, "an animal kingdom with logical relations." Our concepts are derived from natural objects, but in reality do not perfectly correspond to them. The phylogenetic school commits the capital mistake of presenting a transformation which can be realized only in logical concepts, as an actually occurring process, and of confounding an abstract operation with concrete fact. "The logical transformation of the concept ape into the concept man is no genealogical process." The mathematician may logically 'develop' the concept of a circle from that of a polygon, but it by no means follows that the circle is phylo-genetically derived from the polygon.

Because the concept of species is variable, the species themselves, according to Darwin, should be subject to a continual flux; whereas the real cause of the variability which he observed lies in the discrepancy between objective facts and their logical tabulation, in the narrowness of our concepts and in the lack of adequate means of expression. He thus makes natural objects responsible for our logical limitations.

With regard to organisms the Descent-school confounded the purely logical signification of the word "related" with that of blood or family affinity. But surely when they speak of the relation of forms in the crystal systems, they do not refer to genetic connection. To-day

this interchange of concepts is so general that one needs to exercise great care if one would avoid it.

The theory which postulates the blood-relationship of individuals of the same species may be correct, but it is utterly incapable of proof, and the same is true in a greater degree when there is question of individuals of the same class but of different species. Since a direct proof is impossible, an attempt was made to construct an indirect proof by a comparison of bodily-organs. But in so doing the Descent theorizers had to relinquish scientific analysis altogether.

In conclusion Fleischmann states that he does not mean to discard every hypothesis of Descent. He simply gives warning against an over-estimation of the theory. In opposition to those who esteem it as the highest achievement of science, he looks upon it as a necessary evil. Its proper sphere is the laboratory of the man of science, and not the thronging market-place.

"The Descent hypothesis will meet the same fate (be cast aside), since its incompatibility with facts of ordinary observation is manifesting itself. At the time of its appearance in a new form, forty years ago, it exercised a beneficial influence on scientific progress and induced a great number of capable minds to devote themselves to the study of anatomical, palaeontological and evolutionary problems. Meanwhile, however, viewed in the light of a constantly increasing wealth of actual materials, the hypothesis has become antiquated and the labors of its industrious advocates

makes it obvious to unbiased critics, that it is time to relegate it ad acta."

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My own views agree with those of Fleischmann as presented above, except in regard to his last chapter. I must, of course, admit that his criticism has discredited the doctrine of Descent as a scientifically established theory. Hence, as I have always asserted, it must be excluded from the realm of exact science. No doubt people will come gradually to see that the theory involves a creed and therefore belongs to the domain of cosmic philosophy. All this I readily admit.

Not so, however, as regards the concept of "development." It seems to me to be incorrect to regard this as a logical concept only, even with reference to organisms. True, the whole zoological system is in reality nothing more than a logical abstraction. And in view of this fact one must be on one's guard against confusing a logical transformation of concepts with a genealogical development.

We must, however, not forget that we possess the wonderful analogy of ontogeny (individual development) and above all, the fact of mutation and of metagenesis. And even if we wish to avoid the error of Haeckel and others who find a necessary connection between ontogeny and phylogeny, nevertheless the analogy will still entitle us to picture to ourselves the development of the whole range of living organisms. Such a representation will, of course, have only a subjective value.

No doubt, it is logically unjustifiable to argue from the variable concept to the variability of the species. Still there is something real in plants and animals which corresponds to our specific concepts. In some cases the corresponding reality may be so well defined that it is not difficult to form the concept accurately; whereas in other cases where the task is more difficult, the difficulty must be due to the object. Under these circumstances we may safely conclude from the lack of definiteness in our concepts to a certain lack of rigid delimitation in the organic forms.

This blending of certain forms suggests the idea of transformation, but does not furnish definite proof of it. Such proof can be had only by the direct observation of a transformation. And no doubt in certain cases a transformation may occur. As regards animals, I may call attention, for instance, to the experiments made with butterflies by Standfuss, and as regards plants, to the experiments of Haberlandt, of which I treated in Chapter III. The limits within which these transformations take place are indeed very narrow as are also the limits of those indisputable varieties which naturally arise within an otherwise rigidly defined species. I am aware that the transformation of one species into another has not yet been effected, but the above-mentioned attempts at transformation have nevertheless demonstrated that certain organic forms when subjected to changed conditions of life, display certain mutations which clearly show that variability is to be attributed, not, certainly, to the specific concepts, but to the corresponding reality. This observation and reflexion, joined

with the fact that organisms form a progressive series from the simple to the more complex, and with the observed phenomena of individual development, lead me to regard the concept of Descent as admissible, and in a certain sense, even probable. But I agree with Fleischmann in saying that this is a mere belief, and that all attempts to give it a higher scientific value by inductive proof have signally failed.

My standpoint, moreover, requires me to admit the validity of the hypothesis of Descent as an heuristic maxim of natural science. I believe that we shall be justified in the future, as we were forty years ago, in directing our investigation in the direction of Descent, and I do not consider such investigation so utterly hopeless as Fleischmann represents it. However, I entirely concur with him in the opinion that we are here concerned (and shall be for a long time to come) with a mere hypothesis which belongs not in the market-place, nor among the world views of the multitude, but in the study of the man of science.

Above all it must not be mixed up with religious questions. Whether the hypothesis will ever emerge from the study of the man of science as a well-attested law, is still an open question, incapable of immediate solution.

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It is of interest for us to inquire what reception Fleischmann's protest against the theory of Descent has been accorded by his associates.

Fleischmann was formerly an advocate of the theory of Descent. He was a pupil and assistant of Selenka, who

was then at Erlangen (died in Muenster 1902). He had previously written a number of scientific works from the standpoint of the Descent theory. In the year 1891, investigations regarding rodents led him to oppose that theory. During the winter term of 1891-92 he gave evidence of this change in a public lecture. Not until 1895 was there question of his appointment to the chair of zoology in Erlangen. In 1898 he published a Manual of Zoology based on principles radically opposed to the doctrine of Descent. This manual irritated Haeckel so much that he issued one of his well-known articles, *Ascending and Descending Zoology*, in which, after his usual manner, he casts suspicion on Fleischmann of having received his appointment to the chair at Erlangen by becoming an anti-Darwinian in accordance with a desire expressed at the diet of Bavaria. I am not aware that Haeckel has paid any attention to the work of Fleischmann which we have just reviewed.

By its publication, however, the author disturbed a hornet's nest. Dispassionate, but still entirely adverse is Professor Plate's review in the "Biologisches Zentralblatt," while the "Umschau" publishes two criticisms, one by Professor von Wagner, the other by Dr. Reh, which for want of sense could not well be equalled. It was the former who furnished material for our sixth chapter and who there displayed such utter confusion of thought regarding the inductive method. The same confusion is apparent in his recent utterance in which he observes that Fleischmann's whole aim is to accumulate observational data, meanwhile avoiding speculation as far as possible. His criticism is re-

plete with bitter personal epithets, e. g., "reactionary," "mental incompetency," "dishonest mask of hypercritical exactness," which manifest the writer's inability to enter upon an objective discussion of the question.

A still more reprehensible position is assumed by Dr. Reh, who censures Fleischmann for introducing to the general public the question of Descent which belongs properly to the forum of science. He claims that Fleischmann, by so doing, forfeited his right to an unbiased hearing. Dr. Reh forgets that but a short time ago he had no word of censure for Haeckel's *Weltraetsel* which was intended for a far wider circle of readers. He next appropriates Haeckel's suspicion regarding Fleischmann which we noticed above, and then adds the entirely untrue assertion that the first half of Fleischmann's Manual, written before he took possession of the chair in Erlangen, is written in the spirit of Darwin, whereas the second half which appeared at a later date is written in the contrary spirit. He then takes individual points of Fleischmann's treatise out of their context in order to execute a cheap and nonsensical criticism of them. Haeckel has evidently been giving instructions on the best manner of dealing with adversaries. And very docile disciples they are who imitate his method even to the extent of defaming and abusing their scientific opponents.

But is not this another plain indication of the decay of Darwinism? Of course Haeckel recognized at the very beginning of his career that it was necessary to support the theory by means of personal bitterness, forgeries and misrepresentations. But if the last surviving advocates of Dar-

winism must needs have recourse to the same disreputable means, to what a low estate, indeed, has it fallen!

Let us hope that these last wild convulsions are really the signs of approaching dissolution.

No, they are just the pain of labor for a science to be born yet.

CHAPTER X.

In order to judge of the present status of Darwinism it is of primary importance to note the position assumed by the few really eminent investigators, who as pupils of Haeckel still seem to have remained true to him. Among these I reckon Oskar Hertwig, the well known Berlin anatomist.

As early as 1899 in an address at the University on, *Die Lehre vom Organismus und ihre Beziehung zur* **Sozialwissenschaft**, Hertwig gave expression to views which are very little in harmony with the doctrines proceeding from Jena, and which are also put forth in his manual, *The Cell and the Tissue*. In that address we read (p. 8): "With the same right, with which, for the good of scientific progress, an energetic protest has been raised against a certain mysticism which attaches to the word Vitality, I beg to give warning against an opposite extreme which is but too apt to lead to onesided and unreal, and hence also, ultimately to false notions of the vital process, against an extreme which would see in the vital process nothing but a chemico-physical and mechanical problem and thinks to arrive at true scientific knowledge only in so far as it succeeds in tracing back phenomena to the movements of repelling and attracting atoms and in subjecting them to mathematical calculation."

"With right does the physicist Mach, with reference to

such views and tendencies, speak of a 'mechanical mythology in opposition to the animistic mythology of the old religions' and considers both as 'improper and fantastic exaggerations based on a one-sided judgment." "My position on the question just stated becomes apparent from the consideration that the living organism is not only a complex of chemical materials and a bearer of physical forces, but also possesses a special organization, a structure, by means of which it is very essentially differentiated from the inorganic world, and in virtue of which it alone is designated as living."

Here, then, the distinction between living and nonliving nature is clearly and definitely expressed, and Hertwig expresses himself just as definitely when he says (p. 21): "Whereas, but a few decades ago a scientific materialistic conception of the world issuing from a onesided, unhistorical point of view, misjudged the significance of the historic religious and ethical forces in the development of mankind, a change has become apparent in this regard."

To this gratifying testimony against materialism the distinguished naturalist added an equally valuable testimony regarding Darwinism on the occasion of the naturalists' convention in 1900. He there sketched an excellent summary of the "Development of Biology in the Ninteenth Century," in which he decidedly opposes the materialistic-mechanical conception of life. In so doing he also touches upon Haeckel's carbon-hypothesis, to which the latter still clings, and says: "That from the properties of carbon, combined with the properties of oxygen, hydrogen, nitro-

gen, etc., in certain proportions albumen should result, is a process which in its essence is as incomprehensible as that a living cell should arise from a certain organization of different albumina." Then the speaker is inevitably led to speak of the doctrine of Descent and Darwinism.

In the first place he declares definitely that ontogeny alone, i. e., the development of the individual being, is "capable of a direct scientific investigation." On the other hand we move in the domain of hypotheses in dealing with the further question: "How have the species of organisms living to-day originated in the course of the world's history?" This is a very valuable admission in view of Haeckel's dogmatic assertion that the descent of man from the ape is a "certain historical fact." Very moderate and pertinent are also the further words of the speaker: "Of course, a philosophically trained investigator will regard it as axiomatic that the organisms which inhabit our earth to-day did not exist in their present form in earlier periods of the earth and that they had to pass through a process of development, beginning with the simplest forms."

"But in the attempt to outline in detail the particular form in which a species of animals of our day existed in remote antiquity, we lose the safe ground of experience. For out of the countless millions of organisms, that lived in earlier periods of the earth, the duration of which is measured by millions of years, only scanty skeleton remains have by way of exception been preserved in a fossil state. From these naturally but a very imperfect and hypothetical representation can be formed of the soft bodies with which they were

once clothed. And even then it remains forever doubtful whether the progeny of the prehistoric creature, the scant remains of which we study, has not become entirely extinct, so that it can in no way be regarded as the progenitor of any creature living at present." I should like to know wherein this differs radically from Fleischmann's contention in his Descendenztheorie" (p. 10.) For we find stated here what Fleischmann emphasizes so much, viz., that with the problem of Descent we leave the domain of experience. It is worthy of special note in this connection that Hertwig likewise evidently regards as the sole really empirically and inductively serviceable proof of Descent, that which is drawn from palaeontology, from prehistoric animal and plant remains. He makes not the least mention of the indirect proofs taken from ontogenetic development or comparative anatomy, to which the Darwinians and advocates of Descent love so much to appeal, because they feel that the real inductive proof is lacking and totally fails to sustain their position. Hertwig next points out that the problem of Descent stirred scientific as well as lay circles twice during the past century. He then pays Lamarck and Darwin the necessary tribute, at which we cannot take offense since he was reared in the Darwinian atmosphere of Jena. I also willingly admit that Darwinism served science as a "powerful ferment," even if I must emphasize just as decidedly how harmful it was that this "ferment" was introduced into lay circles at an unseasonable time by the apostles of materialism. For while it was very well adapted to bring about in educated circles a fermentation which pro-

duced beneficial results, in uncritical lay-circles this ferment produced nothing but a corruption of world-views.

Hertwig then designates "Struggle for Existence," Survival of the Fittest, and Selection, as "very indefinite expressions." "With too general terms, one does not explain the individual case or produces only the appearance of an explanation whereas in every case the true causative relations remain in the dark. But it is the duty of scientific investigation to establish for each observed effect the prevenient cause, or more correctly, since nothing results from a single cause, to discover the various causes."

"The origin of the world of organisms from natural causes, however, is certainly an unusually complicated and difficult problem. It is just as little capable of being solved by a single magic formula as every disease is of yielding to a panacea. By the very act of proclaiming the omnipotence of natural selection, Weismann found he was forced to the admission that: "as a rule we cannot furnish the proof that a definite adaptation has originated through natural selection," in other words: We know nothing in reality of the complexity of causes which has produced the given phenomenon. So we may on the contrary, with Spencer, speak of the "Impotence of Natural Selection."

"In this scientific struggle with which the past century closed, it seems necessary to distinguish between the doctrine of evolution and the theory of selection. They are based on entirely different principles. For with Huxley we can say: "Even if the Darwinian hypothesis were blown away, the doctrine of Evolution would remain standing

where it stood." In it we possess an acquisition of our century which rests on facts, and which undoubtedly ranks amongst its greatest."

This last sentence affirms exactly what I have repeatedly asserted: the doctrine of Descent remains, Darwinism passes away. Hertwig then is decidedly of opinion that Darwinism entirely fails in the individual case because in its application the basis of experience vanishes. Indeed, according to him, phylogeny is not at all capable of direct scientific investigation. These are all important admissions which one would certainly have considered impossible twenty years ago; they unequivocally indicate the decline of Darwinian views, and in a certain way also harmonize with Fleischmann's work.

True, Hertwig still clings to the thought of Descent, but apparently no longer as to a conclusion of natural science. This appears from the assertion: "Ontogeny alone is capable of a direct scientific (he evidently speaks of natural science) investigation," and from the other statement that a *philosophically* trained investigator will accept it (Descent) as axiomatic although it belongs to the domain of hypothesis. What else does this mean but that: We have no specific knowledge of Descent but we believe in it. In short, this is not natural science but natural philosophy; it forms no constituent part of our certain knowledge of nature but it is one aspect of our world-view.

All the above-quoted assertions of Hertwig are calm

and well-considered and show a decided deviation from the Darwinian position. Above all we are pleased to note that he appropriates Spencer's phrase regarding the "Impotence of Natural Selection" and that in the citation from Huxley he at least admits the possibility that the Darwinian doctrine will be "wafted away."

It is also proper to mention here the fact that in another place Hertwig no longer recognizes so fully the dogma set up by Fritz Mueller and Haeckel which is so closely bound up with Darwinism. I mean the so-called "biogenetic principle" according to which the individual organism is supposed to repeat in its development the development of the race during the course of ages.

In his book: "The Cell and the Tissue" (Die Zelle und die Gewebe, II. Jena 1898, p. 273) Hertwig says: "We must drop the expression: 'repetition of forms of extinct ancestors' and employ instead: repetition of forms which accord with the laws of organic development and lead from the simple to the complex. We must lay special emphasis on the point that in the embryonic forms even as in the developed animal forms general laws of the development of the organized body-substance find expression."

Any one can subscribe to these statements; in truth they contain something totally different from the "biogenetic principle"; for Haeckel has really no interest in so general a truth, but is intent only upon a proof of Descent.

Hertwig continues: "In order to make our train of thought clear, let us take the egg-cell. Since the develop-

ment of every organism begins with it. the primitive condition is in no way recapitulated from the time when perhaps only single-celled amoebas existed on our planet. For according to our theory the egg-cell, for instance, of a now extant mammal is no simple and indifferent, purposeless structure, as it is often represented, (as according to Haeckel's "biogenetic principle" it would necessarily be); we see in it, in fact, the extraordinarily complex end-product of a very long historic process of development, through which the organic substance has passed since that hypothetical epoch of single-celled organisms."

"If the eggs of a mammal now differ very essentially from those of a reptile and of an amphibian because in their organization they represent the beginnings only of mammals, even as these represent only the beginnings of reptiles and amphibians, by how much more must they differ from those hypothetical single-celled amoebas which could as yet show no other characteristics than to reproduce amoebas of their own kind."

This is a view which has frequently been clearly expressed by anti-Darwinians: The egg-cells of the various animals are in themselves fundamentally different and can therefore have nothing in common but similarity of structure. In opposition to Hertwig, Haeckel in his superficial way deduces from it an internal similarity as well. After a few polite bows before his old teacher, Haeckel, Hertwig thus summarizes his view: "Ontogenetic (that is, those stages in the individual development) stages therefore give

us only a greatly changed picture of the phylogenetic (i. e., genealogical) stages as they may once have existed in primitive ages, but do not correspond to them in their actual content." This is a very resigned position, very far removed from Haeckel's certainty and orthodoxy.

To sum up: O. Hertwig has become a serious heretic in matters Darwinian. Will Haeckel, in his usual manner try to cast suspicion on Hertwig also? For Haeckel himself says (Free Science and Free Doctrine, Stuttgart, 1878, p. 85): "Since I am not bound by fear to the Berlin Tribunal of Science or by anxieties regarding the loss of influential Berlin connections, as are most of my like-minded colleagues, I do not hesitate here as elsewhere to express my honest conviction, frankly and freely, regardless of the anger which perhaps real or pretended privy councillors in Berlin may feel upon hearing the unadorned truth."

Verily, it is a matter of suspense to know whether his school will now pour forth their wrath upon O. Hertwig, or whether finally the discovery will not be made in Jena that Hertwig secretly possessed himself of his position in Berlin, in the same manner as Fleischmann obtained his at Erlangen, viz., by a promise of desertion from Darwinism.

CONCLUSION.

We may conveniently summarize what we have said in the foregoing chapters in the following statement: The theory of Descent is almost universally recognized to-day by naturalists as a working hypothesis. Still, in spite of assertions to the contrary, no conclusive proof of it has as yet been forthcoming. Nevertheless it cannot be denied that the theory provides us with an intelligible explanation of a series of problems and facts which cannot be so well explained on other grounds.

On the other hand, Darwinism, i. e., the theory of Natural Selection by means of the Struggle for Existence, is being pushed to the wall all along the line. The bulk of naturalists no longer recognizes its validity, and even those who have not yet entirely discarded it, are at least forced to admit that the Darwinian explanation now possesses a very subordinate significance.

In the place of Darwinian principles, new ideas are gradually winning general acceptance, which, while they are in harmony with the principles of adaptation and use, (Lamarck) enunciated before the time of Darwin, nevertheless attribute a far-reaching importance to *internal forces of development.* These new conceptions necessarily involve the admission that *Evolution has not been a purely mechanical process.*

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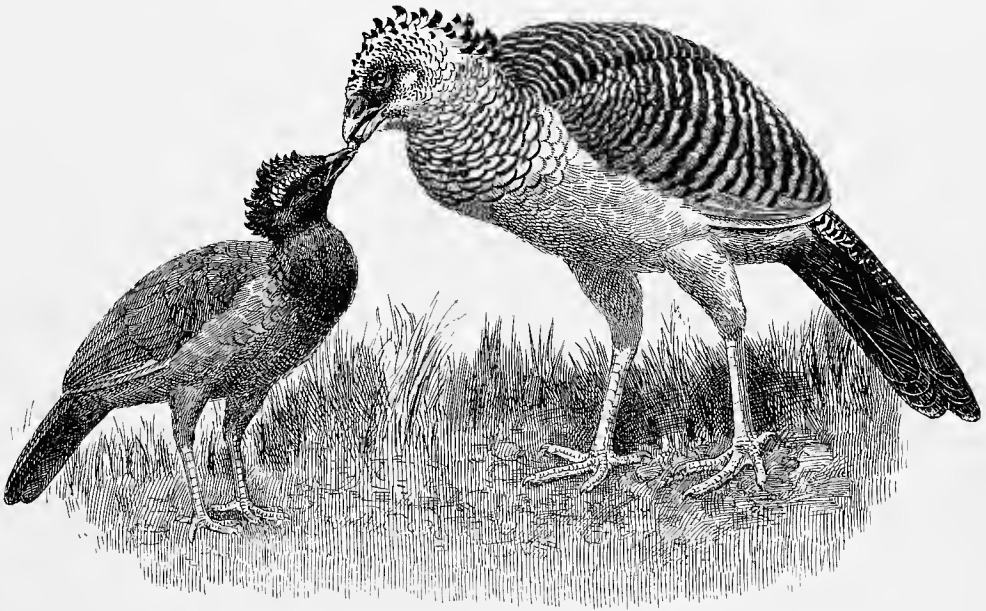
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HEX CURASSOW FEEDING YOUNG BIRD, WHICH HAS THE PLUMAGE OF THE HENS OF THE GLOBOSE CURASSOW, ITS FATHER'S SPECIES

THE MAKING OF SPECIES

BY DOUGLAS DEWAR, B.A. (Cantab), I.C.S., F.Z.S.
AND FRANK FINN, B.A. (Oxon), F.Z.S., M.B.O.U.

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PREFACE

POST-DARWINIAN books on evolution fall naturally into four classes. I. Those which preach Wallaceism, as, for example, Wallace's *Darwinism*, Poulton's *Essays on Evolution*, and the voluminous works of Weismann. II. Those advocating Lamarckism. Cope's *Factors of Evolution* and the writings of Haeckel belong to this class. III. The writings of De Vries, forming a group by themselves. They advocate the theory that species spring suddenly into being; that new species arise by mutations from pre-existing species. IV. The large number of books of a more judicial nature, books written by men who decline to subscribe to any of the above three creeds. Excellent examples of such works are Kellog's *Darwinism To-Day*, Lock's *Recent Progress in the Study of Variation, Heredity, and Evolution*, and T. H. Morgan's *Evolution and Adaptation.*

All four classes are characterised by defects.

Books of the two first classes exhibit the faults of ardent partisanship. They formulate creeds, and, as Huxley truly remarked, "Science commits suicide when it adopts a creed." The

books which come under the third category have the defects of extreme youth. De Vries has discovered a new principle, and it is but natural that he should exaggerate its importance, and see in it more than it contains. But, as time wears on, these faults will disappear, and the theory of mutations will assume its true form and fall into its proper place, which is somewhere between the dustbin, to which Wallaceians would relegate it, and the exalted pinnacle on to which De Vries would elevate it.

In the present state of our knowledge, books of Class IV. are the most useful to the student, since they are unbiassed, and contain a judicial summing-up of the evidence for and against the various evolutionary theories which now occupy the field. Their chief defect is that they are almost entirely destructive. They shatter the faith of the reader, but offer nothing in place of that which they have destroyed. T. H. Morgan's *Evolution and Adaptation*, however, contains much constructive matter, and so is the most valuable work of this class in existence.

Zoological science stands in urgent need of constructive books on evolution — books with leanings towards neither Wallaceism, nor Lamarckism, nor De Vriesism ; books which shall set forth facts of all kinds, concealing none, not even those which do not admit of explanation in the present state of our knowledge.—

It has been our aim to produce a book of this description.

We have endeavoured to demonstrate that neither pure Lamarckism nor pure Wallaceism affords a satisfactory explanation of the various phenomena of the organic world. We have further, while recognising the very great value of the work of De Vries, tried to show that that eminent botanist has allowed his enthusiasm to carry him a little too far into the realm of speculation. We have followed up the exposure of the weak points of the theories, which at present occupy the field, with certain suggestions, which, we believe, throw new light on many biological problems.

Our aim in writing this book has been twofold. In the first place we have attempted to place before the general public in simple language a true statement of the present position of biological science. In the second place, we have endeavoured to furnish the scientific men of the day with food for reflection.

Even as the British nation seems to be slowly but surely losing, through its conservatism, the commercial supremacy it had the good fortune to gain last century, so is it losing, through the unwillingness of many of our scientific men to keep abreast of the times, that scientific supremacy which we gained in the middle of last century by the labours of Charles Darwin and Alfred

Russell Wallace. To-day it is not among Englishmen, but among Americans and Continentals, that we have to look for advanced scientific ideas.

Even as the Ultra-Cobdenites believe that Free Trade is a panacea for all economic ills, so do most English men of science believe that natural selection offers the key to every zoological problem. Both are living in a fool's paradise. Another reason why Great Britain is losing her scientific supremacy is that too little attention is paid to bionomics, or the study of live animals. Morphology, or the science of dead organisms, receives more than its due share of attention. It is in the open, not in the museum or the dissecting-room, that nature can best be studied. Far be it from us to deprecate the study of morphology. We wish merely to insist upon the fact, that the leaders of biological science must of necessity be those naturalists who go to the tropics and other parts of the earth where nature can be studied under the most favourable conditions, and those who conduct scientific breeding experiments. Natural selection—the idea which has revolutionised modern biological science—came, not to professors, but to a couple of field-naturalists who were pursuing their researches in tropical countries. It is absurd to expect those who stay at home and gain most of their

knowledge second-hand to be the pioneers of biological science.

We fear that this book will come as a rude shock to many scientific men. By way of consolation we may remind such that they will find themselves in much the same position as that occupied by theologians immediately after the appearance of the *Origin of Species.*

At that time theological thought was cramped by dogma. But the clergy have since reconsidered their position, they have modified their views, and thus kept abreast of the times. Meanwhile scientific men have lagged behind. The blight of dogma has seized hold of them. They have adopted a creed to which all must subscribe or be condemned as heretics. Huxley said that the adoption of a creed was tantamount to suicide. We are endeavouring to save biology in England from committing suicide, to save it from the hands of those into which it has fallen.

We would emphasise that it is not Darwinism we are attacking, but that which is erroneously called Neo-Darwinism. Neo-Darwinism is a pathological growth on Darwinism, which, we fear, can be removed only by a surgical operation.

Darwin, himself, protested in vain against the length to which some of his followers were pushing his theory. On p. 657 of the new edition

avoid technical terms, and have made a special point of quoting, wherever practicable, familiar animals as examples, in order that the work may make its appeal not only to the zoologist but to the general reader.

It may, perhaps, be urged against us that we have quoted too freely from popular writings, including those of which we are the authors. Our reply to this is that the study of bionomics, the science of living animals, occupies so small a place in English scientific literature that we have been compelled to have recourse to popular works for many of our facts; and we would, moreover, point out that a popular work is not necessarily inaccurate in its information.

In conclusion, we would warn the reader against the danger of confounding Inference with Fact. The failure to distinguish between the two has vitiated much of the work of the Wallaceian school of biologists.

Facts are always to be accepted. Inferences should be scrutinised with the utmost care.

In making our deductions, we have endeavoured to act without bias. We shall, therefore, welcome any new facts, be they consistent with, or opposed to, our inferences.

D. D.
F. F.

CONTENTS

CHAPTER I

PAGE

RISE OF THE THEORY OF NATURAL SELECTION AND ITS SUBSEQUENT DEVELOPMENT . . . 1

Pre-Darwinian Evolutionists—Causes which led to the speedy triumph of the theory of Natural Selection—Nature of the opposition which Darwin had to overcome—Post-Darwinian biology—Usually accepted classification of present-day biologists as Neo-Lamarckians and Neo-Darwinians is faulty—Biologists fall into three classes rather than two—Neo-Lamarckism: its defects—Wallaceism: its defects—Neo-Darwinism distinguished from Neo-Lamarckism and Wallaceism—Neo-Darwinism realises the strength and weakness of the theory of Natural Selection, recognises the complexity of the problems which biologists are endeavouring to solve.

CHAPTER II

SOME OF THE MORE IMPORTANT OBJECTIONS TO THE THEORY OF NATURAL SELECTION . . 30

Brief statement of Theory—Objections to the Theory fall into two classes—Those which strike at the root of the Theory—Those which deny the all-sufficiency of Natural Selection—Objections which strike at root of Theory are based on misconception—Objections to Wallaceism—The Theory fails to explain the origin of Variations—Natural Selection called on to explain too much—Unable to explain beginnings of new organs—The Theory of change of function—The co-ordination of variations—The fertility of races of domesticated animals—Missing links—Swamping effects of intercrossing—Small variations cannot have a survival value—Races inhabiting same area—Excessive specialisation—Chance and Natural Selection—Struggle for existence most severe among young animals—Natural Selection fails to explain mimicry and other phenomena of colour—Conclusion, that scarcely an organism exists which does not possess some feature inexplicable on the theory of Natural Selection as held by Wallace and his followers.

CHAPTER III

PAGE

VARIATION 52

The assumption of Darwin and Wallace that variations are haphazard in origin and indefinite in direction—If these assumptions be not correct Natural Selection ceases to be the fundamental factor in evolution—Darwin's views regarding variation underwent modification—He eventually recognised the distinction between definite and indefinite variations, and between continuous and discontinuous variations—Darwin attached but little importance to either definite or discontinuous variations—Darwin's views on the causes of variations—Criticism of Darwin's views—Variations appear to occur along certain definite lines—There seems to be a limit to the extent to which fluctuating variations can be accumulated—De Vries' experiments—Bateson on "discontinuous variation"—Views held by De Vries—Distinction between continuous and discontinuous variations—The work of De Vries—Advantages enjoyed by the botanist in experimenting on the making of species—Difficulties encountered by the animal breeder—Mutations among animals—The distinction between germinal and somatic variations—The latter, though not transmitted to offspring, are often of considerable value to their possessor in the struggle for existence.

CHAPTER IV

HYBRIDISM 111

The alleged sterility of hybrids a stumbling-block to evolutionists—Huxley's views—Wallace on the sterility of hybrids—Darwin on the same—Wallace's theory that the infertility of hybrids has been caused by Natural Selection so as to prevent the evils of intercrossing—Crosses between distinct species not necessarily infertile—Fertile crosses between species of plants—Sterile plant hybrids—Fertile mammalian hybrids—Fertile bird hybrids—Fertile hybrids among amphibia—Limits of hybridisation—Multiple hybrids—Characters of hybrids—Hybridism does not appear to have exercised much effect on the origin of new species.

CHAPTER V

INHERITANCE 133

Phenomena which a complete theory of inheritance must explain—In the present state of our knowledge it is not possible to formulate a complete theory of inheritance—Different kinds of inheritance—Mendel's experiments and theory—The value and

Contents

PAGE

importance of Mendelism has been exaggerated—Dominance sometimes imperfect—Behaviour of the nucleus of the sexual cell —Chromosomes—Experiments of Delage and Loeb—Those of Cuénot on mice and Castle on guinea pigs—Suggested modification of the generally-accepted Mendelian formulæ — Unit characters—Biological isomerism—Biological molecules—Interpretation of the phenomena of variation and heredity on the conception of biological molecules—Correlation—Summary of the conception of biological molecules.

CHAPTER VI

THE COLOURATION OF ORGANISMS . . . 170

The theory of protective colouration has been carried to absurd lengths—It will not bear close scrutiny—Cryptic colouring —Sematic colours — Pseudo-sematic colours — Batesian and Müllerian mimicry — Conditions necessary for mimicry — Examples—Recognition markings—The theory of obliterative colouration—Criticism of the theory—Objections to the theory of cryptic colouring—Whiteness of the Arctic fauna is exaggerated —Illustrative tables—Pelagic organisms—Objectors to the Neo-Darwinian theories of colouration are to be found among field naturalists—G. A. B. Dewar, Gadow, Robinson, F. C. Selous quoted—Colours of birds' eggs—Warning colouration—Objections to the theory—Eisig's theory—So-called intimidating attitudes of animals—Mimicry—The case for the theory—The case against the theory—"False mimicry"—Theory of recognition colours—The theory refuted—Colours of flowers and fruits —Neo-Darwinian explanations—Objections—Kay Robinson's theory—Conclusion that Neo-Darwinian theories are untenable —Some suggestions regarding the colouration of animals— Through the diversity of colouring of organisms something like order runs—The connection between biological molecules and colour—Tylor on colour patterns in animals—Bonhote's theory of pœcilomeres—Summary of conclusions arrived at.

CHAPTER VII

SEXUAL DIMORPHISM 297

Meaning of the term—Fatal to Wallaceism—Sexual Selection—The law of battle—Female preference—Mutual Selection — Finn's experiments — Objections to the theory of Sexual Selection— Wallace's explanation of sexual dimorphism stated and shown to be unsatisfactory—The explanation of Thomson and Geddes shown to be inadequate—Stolzmann's theory stated and criticised

PAGE

—Neo-Lamarckian explanation of sexual dimorphism stated and criticised—Some features of sexual dimorphism—Dissimilarity of the sexes probably arises as a sudden mutation—The four kinds of mutations—Sexual dimorphism having shown itself, Natural Selection determines whether or not the organisms which display it shall survive.

CHAPTER VIII

THE FACTORS OF EVOLUTION . . . 345

Variation along definite lines and Natural Selection are undoubtedly important factors of evolution—Whether or not sexual selection is a factor we are not yet in a position to decide—*Modus operandi* of Natural Selection—Correlation an important factor—Examples of correlation—Correlation is a subject that requires close study—Isolation a factor in evolution—Discriminate isolation—Indiscriminate isolation—Is the latter a factor?—Romanes' views—Criticism of these—Indiscriminate isolation shown to be a factor—Summary of the methods in which new species arise—Natural Selection does not make species—It merely decides which of certain ready-made forms shall survive—Natural Selection compared to a competitive examination and to a medical board—We are yet in darkness as to the fundamental causes of the Origin of Species—In experiment and observation rather than speculation lies the hope of discovering the nature of these causes.

INDEX 389

LIST OF ILLUSTRATIONS

HECK'S CURASSOW FEEDING YOUNG BIRD, WHICH HAS THE PLUMAGE OF THE HENS OF THE GLOBOSE CURASSOW, ITS FATHER'S SPECIES . *Frontispiece*

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FACING PAGE

A TURBIT BELONGING TO MR H. P. SCATLIFF . 92

From "The Modern Turbit," published by "The Feathered World," London.

YELLOW-RUMPED AND CHESTNUT-BREASTED FINCHES, WITH SPECIMENS IN TRANSITIONAL STATE . 98

On the left, the yellow-rumped finch; on the right, the chestnut-breasted; birds in state of change in the middle.

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MALE AMHERST PHEASANT 122

The chief colours of this species (*Chrysolophus amherstiæ*) are white and metallic green, so that it is very different in appearance from its near ally the gold pheasant.

HARLEQUIN QUAIL (*Coturnix delegorguei*) . 124

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RAIN QUAIL (*Coturnix coromandelica*) . . 124

The markings on the throats of these quails are of the type usually put down as "recognition marks," but as the Harlequin Quail is African and the Rain Quail Indian, the two species cannot possibly interbreed. The pattern, then, can have no "recognition" significance.

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FACING PAGE

BOURU FRIAR-BIRD 222

Like most of the group to which it belongs, this honey-eater (*Tropidorhynchus bouruensis*) is a soberly coloured bird, but is noisy, active, and aggressive.

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BOURU ORIOLE 222

This "mimicking" oriole (*Oriolus bouruensis*) is of the same tone of colour as its supposed model the Friar-bird of the same island.

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KING-CROW OR DRONGO 232

This very conspicuous black bird (*Dicrurus ater*), ranging from Africa to China, is a striking feature of the landscape wherever it occurs.

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DRONGO-CUCKOO 232

The fork of the tail in this bird is unique among cuckoos, but is nevertheless much less developed than in the supposed model, and may be an adaptation for evolutions in flight, as such tails usually appear to be.

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SHIKRA HAWK 236

The upper surface of the tail, not shown in this drawing, exactly corresponds with that of the cuckoo "mimic."

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HAWK-CUCKOO 236

This species (*Hierococcyx varius*) is commonly known in India as the "Brain-fever bird."

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List of Illustrations

FACING PAGE

BRAZILIAN TROUPIAL 284

This species (*Icterus vulgaris*) is that most frequently seen in captivity; the pattern of colour is found in several other allied forms.

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INDIAN BLACK-HEADED ORIOLE 284

Several other orioles besides this (*O. melanocephalus*) have the black head.

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QUEEN WHYDAH 298

This species (*Tetraenura regia*) is a typical example of seasonal sexual dimorphism, the male being long-tailed and conspicuously coloured only during the breeding season, and at other times resembling the sparrow-like female.

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COURTSHIP OF SKYLARK 314

Illustrating display by a species with no decorative colouring or sex difference.

THE MAKING OF SPECIES

CHAPTER I

RISE OF THE THEORY OF NATURAL SELECTION AND ITS SUBSEQUENT DEVELOPMENT

Pre-Darwinian Evolutionists—Causes which led to the speedy triumph of the theory of Natural Selection—Nature of the opposition which Darwin had to overcome—Post-Darwinian biology — Usually accepted classification of present-day biologists as Neo-Lamarckians and Neo-Darwinians is faulty—Biologists fall into three classes rather than two—Neo-Lamarckism: its defects—Wallaceism: its defects—Neo-Darwinism distinguished from Neo-Lamarckism and Wallaceism — Neo-Darwinism realises the strength and weakness of the theory of Natural Selection, recognises the complexity of the problems which biologists are endeavouring to solve.

DARWINISM and evolution are not interchangeable terms. On this fact it is impossible to lay too much emphasis. Charles Darwin was not the originator of the theory of evolution, nor even the first to advocate it in modern times. The idea that all existing things have been produced by natural causes from some primordial material is as old as Aristotle. It was lost

sight of in the mental stagnation of the Middle Ages. In that dark period zoological science was completely submerged. It was not until men shook off the mental lethargy that had held them for many generations that serious attention was paid to biology. From the moment when men began to apply scientific methods to that branch of knowledge the idea of evolution found supporters.

Buffon suggested that species are not fixed, but may be gradually changed by natural causes into different species.

Goethe was a thorough-going evolutionist; he asserted that all animals were probably descended from a common original type.

Lamarck was the first evolutionist who sought to show the means whereby evolution has been effected. He tried to prove that the efforts of animals are the causes of variation; that these efforts originate changes in form during the life of the individual which are transmitted to its offspring.

St Hilaire was another evolutionist who endeavoured to explain how evolution had occurred. He believed that the transformations of animals are effected by changes in their environment. These hypotheses were considered, and rightly considered, insufficient to explain anything like general evolution, so that the idea failed for a time to make headway.

Strength of Darwin's Position

As knowledge grew, as facts accumulated, the belief in evolution became more widespread. Hutton, Lyell, Spencer, and Huxley were all convinced that evolution had occurred, but they could not explain how it had occurred.

Thus, by the middle of last century, all that was needed to make evolution an article of scientific belief was the discovery of a method whereby it could be effected. This Darwin and Wallace were able to furnish in the shape of the theory of natural selection. The discovery was made independently, but Darwin being the older man, the more influential, and the one who had gone the more deeply and carefully into the matter, gained the lion's share of the credit of the discovery. The theory of natural selection is universally known as the Darwinian theory, notwithstanding the fact that Darwin, unlike Wallace, always recognised that natural selection is not the sole determining factor in organic evolution.

From the moment of the enunciation of his great hypothesis, Darwin's position was an exceedingly strong one. Everything was in his favour.

As we have seen, the theory was enunciated at the psychological moment, at the time when zoological science was ripe for it. Most of the leading zoologists were evolutionists at heart, and were only too ready to accept any theory

which afforded a plausible explanation of what they believed to have occurred.

Hence the rapturous welcome accorded to the theory of natural selection by the more progressive biologists.

Another point in Darwin's favour was the delightful simplicity of his hypothesis. Nothing could be more enticingly probable. It is based on the unassailable facts of variation, heredity, and the tendency of animals to multiply in numbers. Everybody knows that the breeder can fix varieties by careful breeding. Darwin had simply to show that there is in nature something to take the part played among domesticated animals by the human breeder. This he was able to do. As the numbers of species remain stationary, it is evident that only a small portion of the animals that are born can reach maturity. A child can see that the individuals most likely to survive are those best adapted to the circumstances of their life. Even as the breeder weeds out of his stock the creatures not suited to his purpose, so in nature do the unfit perish in the everlasting struggle for existence.

In nature there is a selection corresponding to that of the breeder.

It is useless to deny the existence of this selection in nature, this natural selection. The only disputable point is whether such selection can do all that Darwin demanded of it.

The man in the street, then, was able to comprehend the theory of natural selection. This was greatly in its favour. Men are usually well disposed towards doctrines which they can readily understand.

The nineteenth century was a superficial age. It liked simplicity in all things. If Darwin could show that natural selection was capable of producing one species, men were not only ready but eager to believe that it could explain the whole of organic evolution.

The simplicity of the Darwinian theory has its evil side. It has undoubtedly tended to make modern biologists superficial in their methods. It has, indeed, stimulated the imagination of men of science; but the stimulation has not in all cases been a healthy one.

So far from adhering to the sound rule laid down by Pasteur, "never advance anything that cannot be proved in a simple and decisive manner," many modern naturalists allow their imagination to run riot, and so formulate ill-considered theories, and build up hypotheses on the most insecure foundations. "A tiny islet of truth," writes Archdale Reid, "is discovered, on which are built tremendous and totally illegitimate hypotheses."

Another source of Darwin's strength was the vast store of knowledge he had accumulated. For twenty years he had been steadily amassing

facts in support of his hypothesis. He enunciated no crude theory, he indulged in no wild speculations. He was content to marshal a great array of facts, and to draw logical conclusions therefrom. He was as cautious in his deductions as he was careful of his facts. He thus stood head and shoulders above the biologists of his day. He was a giant among pigmies. So well equipped was he that those who attempted to oppose him found themselves in the position of men, armed with bows and arrows, who seek to storm a fortress defended by maxim guns.

Nor was this all. The majority of the best biologists of his time did not attempt to oppose him. They were, as we have seen, ready to receive with open arms any hypothesis which seemed to explain how evolution had occurred. Some of them perceived that there were weak points in the Darwinian theory, but they preferred not to expose these; they were rather disposed to make the best of the hypothesis. It had so many merits that it seemed to them but reasonable to suppose that subsequent investigation would prove that the defects were apparent rather than real.

We hear much of the "magnitude of the prejudices" which Darwin had to overcome, and of the mighty battle which Darwin and his lieutenant Huxley had to fight before the theory of the origin of species by natural selection

obtained acceptance. We venture to say that statements such as these are misleading. We think we may safely assert that scarcely ever has a theory which fundamentally changed the prevailing scientific beliefs met with less opposition. It would have been a good thing for zoology had Darwin not obtained so easy a victory.

Sir Richard Owen, a distinguished anatomist, certainly attacked the doctrine in no unmeasured terms, but his attack was anonymous and so cannot be considered very formidable. Far more important was the opposition of Dr St George Mivart, whose worth as a biologist has never been properly appreciated. His most important work, entitled the *Genesis of Species*, might be read with profit even now by many of our modern Darwinians.

For some time after the publication of the *Origin of Species* Mivart appears to be almost the only man of science fully alive to the weak points of the Darwinian theory. The great majority seem to have been dazzled by its brilliancy.

The main attack on Darwinism was conducted by the theologians and their allies, who considered it to be subversive of the Mosaic account of the Creation. Now, when one whose scientific knowledge is, to say the best of it, not extensive, attacks a man who has studied his subject dispassionately for years, and invariably expresses himself with

extreme caution, the onslaught can have but one result—the attacker will be repulsed with heavy loss, and the onlookers will have a higher opinion of his valour than of his common sense.

The theologians were in the unfortunate position of warriors who do not know what it is against which they are fighting; they confounded natural selection with evolution, and directed the main force of their attack against the latter, under the impression that they were fighting the Darwinian theory.

It was the misfortune of those theologians that it is possible to prove that evolution, or, at any rate, some evolution has occurred; they thus kicked against the pricks with disastrous results to themselves. When this attack had been repulsed men believed that the theory of natural selection had been demonstrated, that it was as much a law of nature as that of gravitation. What had really happened was that the fact of evolution had been proved, and the theory of natural selection obtained the credit. Men thought that Darwinism was evolution. Had the theologians admitted evolution but denied the ability of natural selection to explain it, the Darwinian theory, in all probability, would not have gained the ascendency which it now enjoys.

To us who are able to look back dispassionately upon the biological warfare of the last century, Darwin's opponents—or the majority of them—

appear very foolish. We must, however, bear in mind that at the time of the publication of the *Origin of Species* both natural selection and evolution were comparatively unknown ideas. Darwin had to fight for both. He had to prove evolution as well as natural selection. Many of the facts adduced by him supported both. It is, therefore, not altogether surprising that many of his opponents failed to distinguish between them.

A glance at the *Origin of Species* will suffice to show how considerable is the portion of the book that deals with the evidence in favour of evolution rather than of natural selection.

Of the fourteen chapters which make up the book no fewer than nine are devoted to proving that evolution has occurred. It has been truly said, that for every one fact biologists have found in support of the special theory of natural selection they have found ten facts supporting the doctrine of evolution. Darwin, then, was in the position of a skilled barrister who has a plausible case and who knows the ins and outs of his brief, while his opponents stood in the shoes of inexperienced counsel who had but recently received their brief, and who had not had the time to master the details thereof. In such circumstances it is not difficult to predict which way the verdict of the jury will go.

Darwin, moreover, had a charming personality.

Never was a man with a theory less dogmatic. Never was the holder of a theory more careful of the expressions he used. Never was a scientific man more ready to give ear to his opponents, to meet them half way, and, where necessary, to compromise. Darwin was not afraid of facts, and was always ready to alter his views when they appeared to be opposed to facts. The average scientific man of to-day makes facts fit his theory; if they refuse to fit it he ignores or denies them.

Darwin continually modified his views; when he found himself in a tight place he did not hesitate to resort to Lamarckian factors, such as the inheritance of the effects of use and disuse and of the effects of environment. He conceded that natural selection was insufficient to account for all the phenomena of organic evolution, and advanced the theory of sexual selection in order to account for facts which the major hypothesis seemed to him incapable of explaining.

Darwin, moreover, having ample private means, was not obliged to work for a living, and was therefore able to devote the whole of his time to research. The advantages of such a position cannot be over-estimated, and, perhaps, have not been sufficiently taken into account in apportioning the praise between Darwin and Wallace for their great discovery.

To all these factors in Darwin's favour we

must add his good fortune in possessing so able a lieutenant as Huxley.

Huxley was an ardent evolutionist, an able writer, and a brilliant debater. A man of his mental calibre was able, like a clever barrister, to make out a plausible case for any theory which he chose to take up. While nominally a strong supporter of the Darwinian theory, he was in reality fighting for the doctrine of descent. Had *any* plausible theory of evolution been enunciated, Huxley would undoubtedly have fought for it equally earnestly.

A firm believer in evolution, Huxley was, as Professor Poulton says, confronted by two difficulties, — first, the insufficiency of the evidence of evolution, and, secondly, the absence of any explanation of how the phenomenon had occurred. The *Origin of Species* solved both these difficulties. It adduced much weighty evidence in favour of evolution, and suggested a *modus operandi*. Small wonder, then, that Huxley became a champion of Darwinism. But, as Poulton writes, on page 202 of *Essays on Evolution*, "while natural selection thus enabled Huxley freely to accept evolution, he was by no means fully satisfied with it." "He never committed himself to a full belief in natural selection, and even contemplated the possibility of its ultimate disappearance." To use Huxley's own words: "Whether the particular shape which the

doctrine of evolution, as applied to the organic world, took in Darwin's hands, would prove to be final or not, was, to me, a matter of indifference."

The result of the fortuitous combination of the circumstances which we have set forth was that in a surprisingly short time the theory of natural selection came to be regarded as a law of nature on a par with the laws of gravitation. Thus, paradoxical though it seems, practical certainty was given to a hitherto uncertain doctrine by the addition of a still more uncertain theory.

"At once," writes Waggett, "the theory of development leapt from the position of an obscure guess to that of a fully-equipped theory and almost a certainty."

Darwin thus became a dictator whose authority none durst question. A crowd of slavish adherents gathered round him, a herd of men to whom he seemed an absolutely unquestionable authority. Darwinism became a creed to which all must subscribe. It still retains this position in the popular mind.

The ease with which the theory of natural selection gained supremacy was, as we have already said, a misfortune to biological science. It produced for a time a considerable mental stagnation among zoologists. Since Darwin's day the science has not made the progress that might reasonably have been expected, because the theory has so captivated the minds of the

majority of biologists that they see everything through Darwinian spectacles. The wish has been in many cases the father to the observation. Zoologists are ever on the lookout for the action of natural selection, and in consequence frequently imagine they see it where it does not exist. Many naturalists, consciously or unconsciously, stretch facts to make them fit the Darwinian theory. Those facts which refuse to be so distorted are, if not actively ignored or suppressed, overlooked as throwing no light upon the doctrine. This is no exaggeration. A perusal of almost any popular book dealing with zoological theory leaves the impression that there is nothing left to be explained in the living world, that there is no door leading to the secret chambers of nature to which natural selection is not an "open sesame."

But the triumph of natural selection has not been so complete as its more enthusiastic supporters would have us believe. Some there are who have never admitted the all-sufficiency of natural selection. In the British Isles these have never been numerous. In the United States of America and on the Continent they are more abundant. The tendency seems to be for them to increase in numbers. Hence the recent lamentations of Dr Wallace and Sir E. Ray Lankester. Modern biologists are commonly supposed to fall into two schools of thought—the Neo-Darwinian and the Neo-Lamarckian.

The former are the larger body, and pin their faith absolutely to natural selection. They deny the inheritance of acquired characters, and preach the all-sufficiency of natural selection to explain the varied phenomena of nature. The Neo-Lamarckians do not admit the omnipotency of natural selection. Some of them allow it no virtue. Others regard it as a force which keeps variation within fixed limits, which says to each organism, "thus far shalt thou vary and no farther." This school lays great stress on the inheritance of acquired characters, especially on the inheritance of the effects of use and disuse.

The above statement of the recent developments of Darwinism is incomplete, for it fails to include those who occupy a middle position. If it be possible to classify a large number of men of which scarcely any two hold identical views, it is into three, rather than two, classes that they must be divided.

Speaking broadly, evolutionists of to-day may be said to represent three distinct lines of thought. For the sake of classification we may speak of them as falling into three schools, which we may term the Neo-Lamarckian, the Wallaceian, and the Neo-Darwinian, according as their views incline towards those held by Lamarck, Wallace, or Darwin.

As adherents of the Neo-Lamarckian school,

we cite Cope, Spencer, Orr, Eimer, Naegeli, Henslow, Cunningham, Haeckel, Korchinsky, and a number of others. It may almost be said of these Neo-Lamarckians that each holds a totally distinct theory of evolution. So heterogeneous are their views that it is difficult to find a single article common to the evolutionary belief of all. It is commonly asserted that all Neo-Lamarckians are agreed, firstly, that acquired characters are transmissible; and, secondly, that such transmission is an important factor in the production of new species. This assertion is certainly true of the great bulk of Neo-Lamarckians, but it does not appear to hold in the case of those who believe that evolution is the result of some unknown inner force. So far as we can see, a belief in the inheritance of acquired characters is not necessary to the theories of orthogenesis held by Naegeli and Korchinsky. For that reason it would possibly be more correct to place those who hold such views in a fourth school. Since, however, a number of undoubted Neo-Lamarckians, as, for example, Cope, believe in an inner growth-force, it is convenient to regard Naegeli as a Neo-Lamarckian. His views need not detain us long. Those who wish to study them in detail will find them in his *Mechanisch-physiologische Theorie der Abstammungslehre.*

Naegeli believes that there is inherent in

protoplasm a growth-force, which makes each organism in itself a force making towards progressive evolution. He holds that animals and plants would have become much as they are now even if no struggle for existence had taken place. "To the believers in this kind of . . . orthogenesis," writes Kellog (*Darwinism To-day*, p. 278), "organic evolution has been, and is now, ruled by unknown inner forces inherent in organisms, and has been independent of the influence of the outer world. The lines of evolution are immanent, unchangeable, and ever slowly stretch toward some ideal goal." It is easy to enunciate such a theory, impossible to prove it, and difficult to disprove it.

It seems to us that the fact that, so soon as organisms are removed from the struggle for existence, they tend to degenerate, is a sufficient reason for refusing to accept theories of the description put forth by Naegeli. More truly Lamarckian is Eimer's theory of orthogenesis, according to which it is the environment which determines the direction which variation takes; and the variations which are induced by the environment are transmitted to the offspring.

Spencer and Orr preach nearly pure Lamarckism. The former, while fully recognising the importance of natural selection, considered that sufficient weight has not been given to the effects of use and disuse, or to the direct action

of the environment in determining or modifying organisms.

The similarity of the views of Orr and Lamarck is best seen by comparing their respective explanations of the long neck of the giraffe. Lamarck thought that this was the direct result of continual stretching. The animal continually strains its neck in the search for food, hence it grows longer as the individual grows older, and this elongated neck has been transmitted to the offspring. Orr writes, on page 164 of his *Development and Heredity*: "The giraffe seems to present the most remarkable illustration of the lengthening of the bones as the result of the frequent repetition of such shocks. As is well known, this animal feeds on the foliage of trees. From the earliest youth of the species, and the earliest youth of each individual, it must have been stretching upwards for food, and, as is the custom of such quadrupeds, it must have constantly raised itself off its forefeet, and, as it dropped, must have received a shock that made itself felt from the hoofs through the legs and vertical neck to the head. In the hind legs the shock would not be felt. It is impossible to imagine that an animal which, during the greater part of every day of its life (both its individual and racial life), performed motions so uniform and constant, would not be peculiarly specialised as a result. The forces acting upon such an

animal are widely different from the forces acting upon an animal which eats the grass at its feet like an ox, or one which must run and climb like a goat or a deer, and the resultant modifications of growth in the several cases must also be different. The principle of increased growth in the direction of the shock, resulting from super-abundant repair of the momentary compression, explains how the giraffe acquired the phenomenal length of the bones of its forelegs and neck; and the absence of the shock in the hind-quarters shows why they remained undeveloped and absurdly disproportionate to the rest of the body."

It seems to us that a fatal objection to all these Neo-Lamarckian theories of evolution is that they are based on the assumption that acquired characters are inherited, whereas all the evidence goes to show that such characters are not inherited. In these days, when scientific knowledge is so widely diffused, it is scarcely necessary to say that all the characteristics which an organism displays are either congenital or inborn, or acquired by the organism during its lifetime. Thus a man may have naturally a large biceps muscle, and this is a congenital character; or he may by constant exercise develop or greatly increase the size of the biceps. The large biceps, in so far as it has been increased by exercise, is said to be an

acquired character, for it was not inherited by its possessor, but acquired by him in his lifetime. We must bear in mind that the period in the life history of an organism at which a character appears, is not necessarily a test as to whether it is congenital or acquired, for a great many congenital characters, such as a man's beard, do not appear until some years after birth. As we have seen, the Neo-Lamarckians believe that it is possible for an organism to transmit to its offspring characters which it has acquired during the course of its existence. But, as we have already said, the evidence goes to show that such characters are not inherited. For example, the tail of the young fox-terrier is not shorter than that of other breeds of dogs, notwithstanding the fact that its ancestors have for generations had the greater portion of their caudal appendage removed shortly after birth.

We do not propose to discuss at any great length the vexed question of the inheritance of acquired characters, for the simple reason that the Neo-Lamarckians have not brought forward a single instance which indubitably proves that such characters are inherited.

Mr J. T. Cunningham, in a paper of great value and interest, entitled "The Heredity of Secondary Sexual Characters in relation to Hormones: a Theory of the Heredity of Somatogenic Characters," which appeared in

vol. xxvi., No. 3, of the *Archiv für Entwicklungsmechanik des Organismen*, states: "The dogma that acquired characters cannot be inherited . . . is founded not so much on evidence, or the absence of evidence, as on *a priori* reasoning, on the supposed difficulty or impossibility of conceiving a means by which such inheritance could be effected." Such appears certainly to be true of some zoologists, but we trust that Mr Cunningham will do us the justice to believe that our opinion that the inheritance of acquired characters does not play an important part in the evolution of, at any rate, the higher animals, is based, not on the ground of *a priori* reasoning, but on facts. All the evidence seems to show that such characteristics are not inherited. If, as Mr Cunningham thinks, all secondary sexual characters are due to the inheritance of the effects of use, etc., how is it that no Neo-Lamarckian is able to bring forward a clear case of the inheritance of a well-defined acquired character? If such characteristics are habitually inherited, countless examples should be forthcoming. Fanciers in their endeavours are constantly "doctoring" the animals they keep for show purposes; and it seems to us certain that if acquired characters are inherited, breeders would long ago have discovered this and acted upon the discovery. If Neo-Darwinians are

charged with refusing to believe that acquired characters are inherited because they "cannot conceive the means by which it could be effected,' may it not be said with equal justice that many Neo-Lamarckians believe that acquired characters are inherited, not on evidence thereof, but because if such characters are not inherited it is very difficult to account for many of the phenomena presented by the organic world?

In many of the lower animals, as, for example, the hydra, the germinal material is diffused through the organism, so that a complete individual can be developed from a small portion of the creature. In such circumstances it seems not improbable that the external environment may act directly on the germinal substance, and induce changes in it which may perhaps be transmitted to the offspring. If this be so, it would seem that some acquired characters may be inherited in such organisms. Very many plants can be propagated from cuttings, buds, etc., so that we might reasonably expect some acquired characters to be hereditary in them. The majority of botanists appear to hold Lamarckian views; but on the evidence at present available, it is doubtful whether such views are the correct ones.

Plants are so plastic, so protean, so sensitive to their environment that their external structure appears to be determined by the external conditions in which they find themselves quite as

much as by their inherited tendencies. In this respect they differ very considerably from the higher animals. The peacock, for example, presents the same outward appearance[1] whether bred and reared in Asia or Europe, in a hot or cold, a damp or a dry climate. The same plant, on the other hand, differs greatly in outward appearance according as it is grown in a dry or a damp soil, a hot or a cold country. In his recent book *The Heredity of Acquired Characters in Plants*, the Rev. G. Henslow cites several examples of the celerity with which plants react to their environment. On page 32 he writes: "The following is an experiment I made with the common rest-harrow (*Ononis spinosa, L.*) growing wild in a very dry situation by a roadside. I collected some seeds, and also took cuttings. These I planted in a garden border, keeping this well moist with a hand-light over it, and a saucer of water, so that the air should be thoroughly moist as well. Its natural conditions were thus completely reversed. They all grew vigorously. The new branches of the first year's growth bore spines, proving their hereditary character, but instead of their being long and stout, they were not an inch long, and like needles. This proved the spines to be a hereditary feature. In the second year there were none at all; moreover, the plants

[1] The white, pied, and "Japan" individuals are not more different from the type than some variations occurring in wild birds.

blossomed, and, taken altogether, there was no appreciable difference from *O. repens, L.*"

From this experiment Professor Henslow draws the inference that acquired characters tend to be inherited in plants. In our opinion the experiment affords strong evidence against the Lamarckian doctrine. Here we have a plant which has, perhaps, for thousands of generations developed spines owing to its dry environment. If acquired characters are inherited we should have expected this spiny character to have become fixed and persisted under changed conditions, for some generations at any rate. But what do we find? By the second year the thorns have entirely disappeared. All the years during which the plant was exposed to a dry environment have left no stamp upon it. The fact that the new branches of the first year's growth bore small spines is not, as Professor Henslow asserts, proof of their hereditary character. It merely shows that the initial stimulus to their development occurred while the plant was still in its dry surroundings.

In the same way all other so-called proofs of the heredity of acquired characters break down when critically examined.

In our opinion "not proven" is the proper verdict on the question of the possibility of the inheritance of acquired characters in the higher animals. One thing is certain, and that is that

acquired characters are not commonly inherited in those organisms in which there is a sharp distinction between the germinal and the somatic cells.

It is nothing short of a misfortune that Haeckel's *History of Creation*, which seems to be so widely read in England, should be built on a fallacious foundation. It seems to us that this work is calculated to mislead rather than to teach.

Our attitude is not quite that of the Wallaceian school, which denies the possibility of the inheritance of acquired characters. In practice, however, the attitude we adopt is as fatal to Lamarckism in all its forms as the dogmatic assertions of the Wallaceians. It matters not whether acquired characters are very rarely or never inherited. In either case their inheritance cannot have played an important part in evolution. All those theories which rely on use-inheritance as a factor in evolution are therefore in our opinion worthless, being opposed to facts. Our attitude, then, is that the inheritance of acquired characteristics, if it does occur, is so rare as to be a negligible quantity in organic evolution.

We may add that the position which we occupy will not be affected even if the Lamarckians do succeed eventually in proving that some acquired characters are really inherited. Such proof would

merely help to elucidate some of the problems which confront the biologist. Thus the question of the inheritance of acquired characters, while full of interest, has no very important bearing on the question of the making of species.

The Wallaceians hold the doctrines which have been set forth above as those of the Neo-Darwinian school. It is incorrect to call those who pin their faith to the all-sufficiency of natural selection Neo-Darwinians, because Darwin at no time believed that natural selection explained everything. Darwin moreover was a Lamarckian to the extent that he was inclined to think that acquired characteristics could be inherited. His theory of inheritance by gemmules involved the assumption that such characters are inherited. It is Wallace who out-Darwins Darwin, who preaches the all-sufficiency of natural selection. For this reason we dub the school which holds this article of belief, and to which Weismann, Poulton, and apparently Ray Lankester belong, the Wallaceian school. Weismann has put forth a theory of inheritance, that of the continuity of the germ plasm, which makes this inheritance a physical impossibility. We believe that the Wallaceians have erred as far from the truth as the Lamarckians have, because, as we shall show hereafter, a great many of the organs and structures displayed by organisms cannot be explained on the natural selection hypothesis. Those who

pin their faith to this, needlessly increase the difficulty of the problem which they have to face.

There remains the third school, to which we belong, and of which Bateson, De Vries, Kellog and T. H. Morgan appear to be adherents. This school steers a course between the Scylla of use-inheritance and the Charybdis of the all-sufficiency of natural selection. It may seem surprising to some that we should class De Vries as a Neo-Darwinian, seeing that he is the originator of the theory of evolution by means of mutations, which we shall discuss in Chapter III. of this work. As a matter of fact the theory of mutations should be regarded, not as opposed to the theory of Darwin, but as a theory engrafted upon it. De Vries himself writes :—" My work claims to be in full accord with the principles laid down by Darwin." Similarly Hubrecht writes in the *Contemporary Review* for November 1908: " Paradoxical as it may sound, I am willing to show that my colleague, Hugo de Vries, of Amsterdam, who a few years ago grafted his *Mutations Theorie* on the thriving and very healthy plant of Darwinism, is a much more staunch Darwinian than either Dr Wallace himself, or the two great authorities in biological science whom he mentions, Sir William Thistleton Dyer and Professor Poulton."

Having classified ourselves, it remains for us

(the authors of the present work) to define our position more precisely. Like Darwin we welcome all factors which appear to be capable of effecting evolution. We have no axe to grind in the shape of a pet hypothesis, and consequently our passions are not roused when men come forward with new ideas seemingly opposed to some which already occupy the field. We recognise the extreme complexity of the problems that confront us. We look facts in the face and decline to ignore any, no matter how ill they fit in with existing theories. We recognise the strength and the weakness of the Darwinian theory. We see plainly that it has the defect of the period in which it was enunciated. The eighteenth century was the age of cocksureness, the age in which all phenomena were thought to be capable of simple explanation.

This is well exemplified by the doctrines of the Manchester school as regards political and economic science. The whole art of legislation was thought to be summed up in the words *laissez faire*. The whole sphere of legitimate government was asserted to be the keeping of order and the enforcing of contracts. Experience has demonstrated that a State guided solely by these principles is wretchedly governed. A large proportion of recent Acts of Parliament limits the freedom of contract. Such limitations are necessary in the case of contracts between the weak and

the strong. Similarly the earlier economists considered political economy a very simple affair. They asserted that men are actuated by but one motive—the love of money. All their men were economic men, men devoid of all attributes save an intense love of gold. Experience has shown that these premises are not correct. Love of family, pride of race, caste prejudices are more or less deeply implanted in men, so that they are rarely actuated solely by the love of money.

Thus it is that the political economy of to-day as set forth by Marshall is far more complex and less dogmatic than that of Ricardo or Adam Smith. Similarly the political philosophy of Sidgwick is very different to that of Herbert Spencer. So is it with the theory of organic evolution. The theory of natural selection is no more able to explain all the varied phenomena of nature than is Ricardo's assumption that all men are actuated solely by the love of money capable of accounting for the multifarious existing economic phenomena. Even as the love of wealth is an important motive of human actions, so is natural selection an important factor in evolution. But even as the majority of human actions are the resultant of a variety of motives, so are the majority of existing organisms the resultant of a complex system of forces. Even as it is the duty of the economist to discover the various

motives which lead to human actions, so is it the duty of the biologist to bring to light the factors which are operative in the making of species.

CHAPTER II

SOME OF THE MORE IMPORTANT OBJECTIONS TO THE THEORY OF NATURAL SELECTION

Brief statement of Theory—Objections to the Theory fall into two classes—Those which strike at the root of the Theory—Those which deny the all-sufficiency of Natural Selection—Objections which strike at root of Theory are based on misconception—Objections to Wallaceism—The Theory fails to explain the origin of Variations—Natural Selection called on to explain too much—Unable to explain beginnings of new organs—The Theory of change of function—The co-ordination of variations—The fertility of races of domesticated animals—Missing links—Swamping effects of intercrossing —Small variations cannot have a survival value—Races inhabiting same area—Excessive specialisation—Chance and Natural Selection—Struggle for existence most severe among young animals—Natural Selection fails to explain mimicry and other phenomena of colour—Conclusion, that scarcely an organism exists which does not possess some feature inexplicable on the theory of Natural Selection as held by Wallace and his followers.

"THE burden of proof is on him who asserts" is a rule of evidence which the man of science should apply as rigidly as does the lawyer. It is therefore incumbent upon us to prove our assertion that the theory of natural selection does not afford an adequate explanation of all the varied phenomena observed in the organic world.

Theory of Natural Selection

The theory of natural selection is so generally understood, that to set it forth in detail in this place would be quite superfluous.

Darwin, it will be remembered, based his great hypothesis on the following observed facts :—

1. No two individuals of a species are exactly alike. This is sometimes called the law of variation.

2. All creatures tend in a general way to resemble their parents in appearance more closely than they resemble individuals not related to them. This may be termed the law of heredity.

3. Each pair of organisms produces in the course of a lifetime, on an average, many more than two young ones.

4. On an average the total number of each species remains stationary.

From (3) and (4) follows the doctrine of Malthus, namely, that many more individuals are born than can reach maturity.

Darwin applied this doctrine to the whole of the animal and the vegetable kingdoms.

In his introduction to *The Origin of Species* he writes :—" As many more individuals of each species are born than can possibly survive ; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary, however slightly, in any manner pro-

fitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be naturally selected. From the strong principle of inheritance, any selected variety will tend to propagate its new and modified form."

In other words, the struggle for existence amongst all organic beings throughout the world, which inevitably follows from the high geometrical ratio of their increase, results in the survival of the fittest, that is to say, of those best adapted to cope with their enemies and to secure their food. Since organisms are thus naturally selected in nature, we may speak of a natural selection which acts in much the same way as the human breeder does. Darwin's theory, then, is that all the variety of organisms which now exist have been evolved from one or more forms by this process of natural selection.

The objections which have been urged against the theory of natural selection fall into two classes.

I. Those which strike at its root, which either deny that there is any natural selection, or declare that it is not capable of producing a new species.

II. Those which are directed against the all-sufficiency of natural selection to account for organic evolution.

Those of the first class need not detain us

long, although among those who formulate them are to be found some eminent men of science.

Delage alleges that selection is powerless to form species, its function is, according to him, limited to the suppression of variations radically bad, and to the maintaining of a species in its normal character. It is thus an inimical factor in evolution, a retarder rather than an accelerator of species-change. It merely acts by preserving the type at the expense of the variants, and so acts as a brake on evolution.

Korschinsky, while possibly not denying that selection occurs in nature, declares that its influence on evolution is *nil*, or, if it has any influence, that it is a hindering one.

Eimer similarly denies any capacity on the part of natural selection to create species.

Pfeffer urges a very different objection. He says that if such a force as natural selection existed it would transform species much more rapidly than it does!

Now, in order that the above objections can carry any weight, one of two sets of conditions must be fulfilled.

Either all organisms must be perfectly adapted to their environment, and this environment must never change, or there must be inherent in each species a kind of growth-force which impels the species to develop in certain fixed directions.

In either of these circumstances natural selection will be an inhibitory force, for if the normal organism is perfectly adapted to its environment, all variations from the type must be unfavourable, and natural selection will weed out the individuals that display them. No careful student of nature can maintain, either that all animals are perfectly adapted to their environment, or that this never changes. Hence those who deny that natural selection is a factor in the making of species, assume the second set of conditions, that species develop in certain fixed directions, being impelled either by internal or external forces. How far these ideas are founded on fact we shall endeavour to determine when speaking of variation. It must suffice at present to say that even if any of these views of orthogenesis be established, natural selection will have, so to speak, a casting vote, it will decide which series of species developing along preordained lines shall survive and which shall not survive.

Thus we reach by a different line of argument the conclusion we arrived at in the last chapter: namely, there is no room for doubt that natural selection is a factor in the making of species.

We must now pass on to the second class of objections, those which are urged against the all-sufficiency of natural selection. So numerous are these that it is not feasible to consider them all. A brief notice of the more important ones

should suffice to satisfy any unbiassed person; firstly, that natural selection is an important factor in evolution; secondly, that the position taken up by Wallace and his followers, that natural selection, acting on minute variations, is the one and only factor in organic evolution, is untenable.

1. It has been urged that the Darwinian theory makes no attempt to explain variation, and that, until we know what it is that causes variations, we are not in a position to explain evolution. This of course is quite true, but the objection is scarcely a fair one, since, as we have seen, Darwin freely admitted that his theory made no attempt to explain the origin of variations. It is not reasonable to object to a theory because it fails to explain phenomena with which it expressly states that it is not concerned. On the other hand, the objection is one that must be reckoned with, for, as we shall see, it makes a great difference to the importance of natural selection as a factor in evolution if variations appear indiscriminately in all directions, as Darwin tacitly assumed they do, or whether, as some biologists believe, they are determinate in direction, being the result of a growth-force inherent in all organisms.

2. Very similar to the above-mentioned objection is that which points out that it is a long journey from Amoeba to man. It is difficult to

believe that this long course of development from the simple to the complex is due to the action of a blind force, to the survival of those whose fortuitous variations happen to be best adapted to the environment. The result seems out of all proportion to the cause. There must be some potent force inherent in protoplasm, or behind organisms, impelling them upwards. This objection is as difficult to refute as it is to establish. It is purely speculative.

3. A very serious objection to the Darwinian theory is that the beginnings of new organs cannot be explained by the action of natural selection on fortuitous minute variations, and natural selection can act on an organ only when that organ has attained sufficient size to be of practical utility to its possessor. When once an organ has come into being it is not difficult to understand how it can be improved, modified and developed by natural selection. But how can we explain the origin of an organ such as a limb by the action of natural selection on minute variations?

The theory of the change of function goes some way towards meeting the difficulty, for by means of it we are able to understand how certain organs, as, for example, the lung of air-breathing animals, might have come into existence. This is said to have been developed from the swimming-bladder of fishes. This bladder is,

to use the words of Milnes Marshall, "a closed sac lying just underneath the vertebral column. In many fish it acquires a connection by a duct with some part of the alimentary canal. It then becomes an accessory breathing organ, especially in those fish which are capable of living out of water for a time, *e.g.* the *Protopterus* of America. An interesting series of modifications exists connecting the air-bladder with the lung of the higher vertebrates, which is undoubtedly the same organ."

This theory, however, does not seem adequate to explain the origin of all organs. It does not explain, for example, how limbs developed in a limbless organism. Wallace tried to avoid the difficulty by asserting that it is unreasonable to ask a new theory that it shall reveal to us exactly what took place in remote geological ages and how it took place. To this the obvious reply is, firstly, that we ought not to give unqualified acceptance to any theory of evolution until it does afford us such explanations, and, secondly, that the theory of the origin of species by means of natural selection is no longer a new one.

Latterly, however, Wallace appears to have given up all hope of being able to account for the origin of new organs by means of natural selection, for he states on page 431 of the issue of the *Fortnightly Review* for March 1909:

"It follows—not as a theory but as a fact—that whenever an advantageous variation is needed, it can only consist in an increase or decrease of some power or faculty already existing." Now, in order for an increase or decrease to occur, there must be something in existence to be increased or diminished. Wallace, it is true, speaks here only of powers and faculties; but it can scarcely be supposed that he believes that variations as to structure are intrinsically different from those relating to powers and faculties.

4. Herbert Spencer urges, as an objection to the theory of natural selection, that favourable variations in one organ are likely to be counterbalanced by unfavourable variations in some other organ. He maintains that the chances are enormous against the occurrence of the "many coincident and co-ordinated variations" that are necessary to create a life or death determining advantage.

This objection was urged by a writer in the *Edinburgh Review* in January 1909, and even by Wallace himself in the *Fortnightly Review* last March against the mutation theory. This objection, strong though it appears on paper, exists only in the imagination of the objector.

Those who urge it display a misunderstanding of the manner in which natural selection acts, and ignorance of the phenomenon of the correlation of organs.

Correlation

Natural selection deals with an organism as a whole. Its effect is to permit those creatures to survive which, taken as a whole, are best adapted to their environment.

Physiologists insist with ever-increasing emphasis that there is more or less correlation and inter-connection between the various parts of an organism.

The several organs of an animal are not so many isolated units. It is impossible to act on one organ without affecting some or all of the others.

Variations in a given direction of one organ are usually accompanied by correlated variations in some of the other organs. If strength be of paramount importance to an animal, natural selection will tend to preserve those individuals which exhibit strength to a marked degree, and this exhibition of strength may be accompanied by other peculiarities, such as short legs or a certain colour, so that natural selection will indirectly tend to produce individuals with short legs and having the colour in question, and it may happen that this particular colour is one that renders the animal more conspicuous than the normal colour does. Nevertheless, on account of the all-needful strength which accompanies it, those animals so coloured may survive while those of a more protective hue perish. Thus, paradoxical though it seems, natural selection

may indirectly be responsible for characteristics which in themselves are injurious to the individual. This is probably the case as regards the decorative plumage of some male birds. The phenomenon of correlation was recognised by Darwin, and has, we believe, played an important part in the making of species. We shall deal more fully with the subject in a later chapter.

5. An oft-urged objection to the theory of natural selection, and one which weighed very strongly with Huxley, is that breeders have hitherto not succeeded in breeding a variety which is infertile with the parent species. If, Huxley asked, breeders cannot produce such a thing, how can we say we consider it proved that natural selection produces new species in nature? This objection, however, loses much of its force in view of the fact that many perfectly distinct species are quite fertile when bred together. We shall recur to this in Chapter IV.

6. The fact that palæontology has hitherto failed to yield links connecting many existing species is a classical objection to the theory of the origin of species by gradual evolution.

Wallace states this objection as follows, on page 376 of his *Darwinism*: "Many of the gaps that still remain are so vast that it seems incredible to these writers that they could ever have been filled up by a close succession of

species, since these must have been spread over so many ages, and have existed in such numbers, that it seems impossible to account for their total absence from deposits in which great numbers of species belonging to other groups are preserved and have been discovered."

Wallace's reply is to the effect that in the case of many species palæontology affords abundant evidence of the gradual change of one species into another, the foot of the horse being a well-known case. The genealogy of this noble quadruped can be traced from the Eocene four-toed *Orohippus*, through the *Mesohippus*, the *Miohippus*, the *Protohippus*, and the *Pliohippus*, until we reach the one-toed *Equus*.

Wallace further points out that in order that the fossil of any organism may be preserved, the "concurrence of a number of favourable conditions" is required, and against this the chances are enormous. Lastly, he urges the imperfection of our knowledge of the things that lie embedded in the earth's crust.

The objection based on the lack of "missing links" loses some of its force if we accept the theory that species sometimes arise as sports. Thus, suppose a species with well-developed horns produces as a mutation a hornless variety, which eventually replaces the horned form, we should look in vain for any forms intermediate between the parent and the daughter species.

On the other hand, it is significant that just where the links are most needed they are missing. For example, the splint bones of the horse, taken in conjunction with the feet of existing tapirs, which have four toes in front and three behind, would have led us to infer, without the help of the geological record, that the horse was a descendant of a polydactyle ancestor. When, however, we come to the origin of birds, bats, and whales, palæontology fails to give us any assistance, so that we are in the dark as to the origin of such really important modifications.

7. The swamping effects of inter-crossing is an objection which has been repeatedly urged against the Darwinian theory.

This objection is not so serious as it appears at first sight. Darwin and Wallace maintain, firstly, that natural selection acts by eliminating all individuals except those which present favourable variations. The favoured few alone survive and mate with one another, so that there is here no question of the swamping effects of inter-crossing, none but well-adapted individuals being left to mate with one another.

The objection gains greater force when directed against the theory that evolution proceeds by sudden jumps. But in this connection we must bear in mind that the experiments of Mendel and his followers have demonstrated that some of the offspring of crosses may resemble their

pure ancestors and breed true *inter se*. Nor is this all.

Experience shows that where a mutation, or sport, or discontinuous variation occurs, it frequently repeats itself; for example, the black-winged sport of the peafowl has occurred several times over and in different flocks of birds. The sport or mutation must have a definite cause. There must be something within the organism, something in the generative cells, which causes the mutation to arise; and hence, on *a priori* grounds, we should expect the same mutation to arise about the same time in many individuals. It seems legitimate to infer that things have been quietly working up to a climax. When this is reached there results a mutation. Therefore we should expect sudden mutations to appear simultaneously in a number of individuals. To this important subject we shall return.

8. An almost insuperable objection to the theory that species have originated by the action of natural selection on minute variations, is that such small differences cannot be of a life-or-death value, or, as it is usually called, a survival value to their possessor. But if evolution is the result of the preservation by natural selection of such slight variations, it is absolutely necessary that each of these should possess a survival value.

As D. Dewar has pointed out, on page 704 of vol. ii. of *The Albany Review*, it is only when the

beast of prey and its victim are evenly matched as regards fleetness and power of endurance that small variations in these qualities can have a survival value. But in the rough and tumble of the struggle for existence the victim and its foe are but rarely well-matched. Take as an example the case of a flycatcher. "This bird," writes D. Dewar, "will sometimes take three or four insects in the course of one flight; all are captured with the same ease, although the length of wing in each victim varies. So great is the superiority of the bird that it does not notice the difference in the flying powers of its puny quarry." It is unnecessary to labour this point.

9. Species or varieties differing considerably in colour may exist side by side, as the hooded and carrion crows, the white and dark breasted forms of the Arctic skua, the pale and dark forms of the fulmar petrel, the grey and rufous forms of the American scops owl (*Megascops asio*).

It is true that preponderance of one form or another in certain districts points to some advantage possessed by one over the other, but, for all we know, it may be due to heredity, and in any case the co-existence of the two types in part of their range, or at certain seasons, shows that selection is not at all rigorous.

The same argument applies to the co-existence of very differently-coloured species with generally

similar habits, such as that of the jaguar and puma in South America, and the five very differently-coloured flycatchers in the Nilgiri Hills.

In short, there is abundant evidence to show that considerable differences in colour do not appear to have any effect on the chances of survival in the struggle for existence of those that display them. Yet this is precisely what the supporters of the Darwinian hypothesis cannot afford to admit, for they then find it impossible to account for the origin of such a form as *Kallima*, the leaf-butterfly, by the action of natural selection. As most people are aware, this creature displays a remarkable resemblance to a decaying leaf. "These butterflies" (there are several species which show the marvellous imitation), writes Kellog, on page 53 of *Darwinism To-day*, "have the under sides of both fore and hind wings so coloured and streaked that when apposed over the back in the manner common to butterflies at rest, the four wings combine to resemble with absurd fidelity a dead leaf still attached by a short petiole to the twig or branch. I say absurd, for it seems to me the resemblance is over-refined. Here for safety's sake it is no question of mimicking some one particular kind of other organism or inanimate thing in nature which birds do not molest. It is simply to produce the effect of a dead leaf on a branch.

Leaf-shape and general dead-leaf colour-scheme are necessary for this illusion. But are these following things necessary? namely, an extraordinarily faithful representation of mid-rib and lateral veins, even to faint microscopically-tapering vein tips; a perfect short petiole produced by the apposed 'tails' of the hind-wings; a concealment of the head of the butterfly so that it shall not mar the outlines of the lateral margin of the leaf; and finally, delicate little flakes of purplish or yellowish brown to mimic spots of decay and fungus-attacked spots in the leaf! And, as culmination, a tiny circular clear spot in the fore-wings (terminal part of the leaf) which shall represent a worm-eaten hole, or a piercing of the dry leaf by flying splinter, or the complete decay of a little spot due to fungus growth! A general and sufficient seeming of a dead leaf, object of no bird's active interest, yes, but not a dead leaf modelled with the fidelity of the waxworkers in the modern natural history museums. When natural selection has got Kallima along to that highly desirable stage when it was so like a dead leaf in general seeming that every bird sweeping by saw it only as a brown leaf clinging precariously to a half-stripped branch, it was natural selection's bounden duty, in conformance to its obligations to its makers, to stop the further modelling of Kallima and just hold it up to its hardly won advantage. But what happens?

Kallima continues its way, specifically and absurdly dead-leafwards, until to-day it is a much too fragile thing to be otherwise than very gingerly handled by its rather anxious foster-parents, the Neo-Darwinian selectionists." It is obvious that if natural selection has produced so highly specialised an organism as the dead-leaf butterfly, every minute variation must be of value and have been seized upon by natural selection.

Thus the Wallaceians are on the horns of a dilemma. If they assert, as they appear to do, that every infinitesimal variation has a survival value, they find it difficult to explain the existence, side by side of such forms as the hooded and carrion crows, to say why in some species of bird both sexes assume a conspicuous nuptial plumage at the very time when they stand most in need of protective coloration, why the cock paradise flycatcher is chestnut for the first two years of his life and then turns as white as snow. If, on the other hand, the Wallaceians assert that small variations are unimportant and have no survival they are, as Kellog points out, in trouble over the close and detailed resemblance which the Kallima butterflies bear to dead leaves.

10. An objection to the Darwinian theory which has been advanced by Conn, Henslow, D. Dewar, and others, is that the selection theory fails to take into account the effects of chance. "If,"

writes D. Dewar on page 707 of *The Albany Review*, vol. ii., "the struggle for existence were of the nature of a race at a well-regulated athletic meeting, where the competitors are given a fair start, where there is no difference in the conditions to which the various runners are subjected, then indeed would every variation tell. I would rather liken the struggle for existence to the rush to get out of a crowded theatre, poorly provided with exits, when an alarm of fire is given. The people to escape are not necessarily the strongest of those present. Propinquity to a door may be a more valuable asset than strength."

Or again, we may take the imaginary case of some antelopes being pursued by wolves. The chase, being prolonged, brings the antelopes to a locality with which they are not familiar. The foremost of the herd, the most swift, and therefore the individual which should stand the best chance of survival, suddenly finds himself on soft boggy ground, which, owing to the depth to which his feet sink into the soil, seriously impedes his progress. His fellow antelopes, now outdistanced, seeing his predicament, take another course and soon leave him behind, to fall an easy prey to his foes. Here we have a case of the perishing of the most fit as regards the important point of speed.

Writing of plants, Professor Henslow says, on page 16 of *The Heredity of Acquired Characters*

in Plants: "As the whole of the animal kingdom ultimately lives upon the vegetable, plants must supply the entire quantity of food supplied, not to add innumerable vegetable parasites as well, for both young and old. Myriads of germinating seeds perish accordingly, being destroyed by slugs and other mollusca, and 'mildews,' etc. But far more seeds and spores — about 50,000,000 of these it is calculated can be borne in a single male-fern — never germinate at all. They fall where the conditions of life are unfavourable and perish. This misfortune is not due to any inadaptiveness in themselves, but to the surrounding conditions which will not let them germinate. Thus thousands of acorns and other fruits, as of elder, drop upon the ground in and by our hedges, road-sides, copses, and elsewhere; but scarcely any or even no seedlings are to be seen round the trees."

Every year thousands of birds perish in the great migratory flight, others succumb in a cyclone, a fierce tropical storm, a prolonged drought, a severe frost. Here death overtakes multitudes, all that dwell in a locality, the weak and the strong, the swift and the slow alike.

This objection may be met by saying that in the long run it is the fittest that will survive. This is true. The objection is nevertheless of importance in showing how exceedingly uncertain must be the action of natural selection if it have but

small variations upon which to work. In such circumstances the mills of natural selection may grind surely, but they must grind very slowly.

11. We must bear in mind that the struggle for existence is most severe among young animals, among creatures that are not fully developed. Nature pays no attention to potentialities. The weak go to the wall in the conflict, even though, if allowed time, they might develop into prodigies of strength.

Moreover, and this is an important point, death in the case of young creatures overtakes broods and families rather than individuals.

The above-cited objections to the theory that species have originated by the action of natural selection on minute variations, are mostly of a general nature; let us now notice briefly a few more concrete objections. We shall not devote much space to these in the present chapter, since we shall be continually confronted with them when dealing with the subject of animal colouring.

12. Natural selection, as we shall see, fails to account for the origin of what is known as protective mimicry. Some insects look like inanimate objects, others resemble other insects which are believed or known to be unpalatable. Those creatures displaying this resemblance to other objects or creatures, and deriving profit therefrom, are said to "mimic" the objects or creatures they copy. They are also called "Mimics."

It is easy to understand the profit that these mimics derive from their mimicry. When once the disguise has been assumed we can comprehend how natural selection will tend to improve it by eliminating those that mimic badly; but it seems to us that the theory fails utterly to account for the origin of the likeness.

13. Similarly, the Neo-Darwinian theory fails to explain the colours of the eggs of birds laid in open nests, why, for example, the eggs of the accentor or hedge-sparrow are blue and those of the doves are white.

14. The theory fails to give a satisfactory explanation of the phenomena of sexual dimorphism. Why, for example, in some species of doves and ducks, thesexes are alike, while in other species with similar habits they differ in appearance.

15. It fails to explain why the rook is black and why the jackdaw has a grey neck.

These and many other objections we shall deal with more fully in the chapter on animal colouration. It must suffice here to mention them, and to say that our experience teaches us that scarcely a single species of bird or beast exists which does not display some characteristic which is inexplicable on the theory that natural selection, acting on small variations, is the one and only cause of organic evolution.

CHAPTER III

VARIATION

The assumption of Darwin and Wallace that variations are haphazard in origin and indefinite in direction—If these assumptions be not correct Natural Selection ceases to be the fundamental factor in evolution—Darwin's views regarding variation underwent modification—He eventually recognised the distinction between definite and indefinite variations, and between continuous and discontinuous variations—Darwin attached but little importance to either definite or discontinuous variations—Darwin's views on the causes of variations—Criticism of Darwin's views—Variations appear to occur along certain definite lines—There seems to be a limit to the extent to which fluctuating variations can be accumulated—De Vries' experiments—Bateson on "discontinuous variation"—Views held by De Vries—Distinction between continuous and discontinuous variations—The work of De Vries—Advantages enjoyed by the botanist in experimenting on the making of species—Difficulties encountered by the animal breeder—Mutations among animals—The distinction between germinal and somatic variations—The latter, though not transmitted to offspring, are often of considerable value to their possessor in the struggle for existence.

AS we have already seen, the Darwinian theory, unlike that of Lamarck, does not attempt to explain the origin of variations. It is content with the fact that variations do occur.

Although Darwin did not try to explain how it is that variation occurs, and was very guarded

in the expressions he used concerning it, he assumed that variations are indefinite in variety and occur indiscriminately in all directions, as the following quotations from the *Origin of Species* will show: "But the number and diversity of inheritable deviations of structure . . . are endless" (page 14, ed. 1902). "The variations are supposed to be extremely slight, but of the most diversified nature." "I have hitherto sometimes spoken as if the variations so common and multiform with organic beings under domestication, and in a lesser degree to those under nature, were due to chance. This, of course, is a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of each particular variation" (page 164).

Wallace is far less guarded in his expressions. On page 82 of his *Darwinism* he speaks of "the constant and large amount of variation of every part in all directions . . . which must afford an ample supply of favourable variations whenever required."

The double assumption that variations are for all practical purposes haphazard in origin and indefinite in direction is necessary if natural selection is to be the main factor in evolution. For if variations be not haphazard, if they are definite, if there be a directive force behind them, like fate behind the classical gods, then selection is not the fundamental cause of evolution. It

can at most effect, not the origin of species, but the survival of certain species which have arisen as the result of some other force. Its position is changed; it is no longer a cause of the origin of new organisms, but a sieve determining which of certain ready-made forms shall survive. Evidently, then, we shall not be able to fully understand the evolutionary process until we have discovered how it is that variations are caused. In other words, we must go considerably farther than Darwin attempted to do.

Before proceeding to inquire into the true nature of variations, it behoves us to set forth briefly the ideas of Darwin on the subject. We shall then be in a position to see how much progress has been made since the days of that great biologist.

It is not at all easy to discover exactly what were Darwin's views on the subject of variation. A perusal of his works reveals contradictions, and gives one the impression that he himself scarcely knew his own mind upon the subject. This should not be a matter for surprise.

We must remember that Darwin had to do pioneer work, that he had to deal with altogether new conceptions. Such being the case, his ideas were of necessity somewhat hazy; they underwent considerable modification as fresh facts came to his knowledge.

Towards the end of his life Darwin recognised

that variability is of two kinds—definite and indefinite. Indefinite variation is indiscriminate variation in all directions around a mean, variation which obeys what we may perhaps call the law of chance. Definite variation is variation in a determinate direction—variation chiefly on one side of the mean. Darwin believed that these determinate variations were caused by external forces, and that they are inherited. He thus accepted Lamarckian factors. "Each of the endless variations," he writes, "which we see in the plumage of our fowls, must have had some efficient cause, and if the same causes were to act uniformly during a long series of generations on many individuals, all probably would be modified in the same direction."

But Darwin was always of opinion that this definite variability, this variability in one direction as the result of some fixed cause, is far less important, from an evolutionary point of view, than indefinite variability, that it is the exception rather than the rule, that the usual result of changed conditions is to let loose a flood of indefinite variability, that it is almost exclusively upon this that natural selection acts.

Darwin also recognised that variations differ in degree, even as they do in kind. He perceived that some variations are much more pronounced than others. He recognised the distinction between what are now known as

continuous and discontinuous variations. The former are slight departures from the normal; the latter are considerable deviations from the mean or mode; great jumps, as it were, taken by nature, as, for example, the pea and the rose combs of fowls, which were derived from the normal single comb.

"At long intervals of time," wrote Darwin, "out of millions of individuals reared in the same country and fed on nearly the same food, deviations of structure so strongly pronounced as to deserve to be called monstrosities arise, but monstrosities cannot be separated by any distinct line from slighter variations." Therefore it is evident that he regarded the difference between continuous and discontinuous variations as not one of kind, but merely of degree. To the discontinuous variations Darwin attached very little importance from an evolutionary point of view. He looked upon them as something abnormal.

"It may be doubted," he wrote, "whether such sudden and considerable deviations of structure such as we occasionally see in our domestic productions, more especially with plants, are ever permanently propagated in a state of nature. Almost every part of every organic being is so beautifully related to its complex conditions of life that it seems as improbable that any part should have been suddenly pro-

duced perfect, as that a complex machine should have been invented by a man in a perfect state. Under domestication monstrosities sometimes occur which resemble normal structures in widely different animals. Thus pigs have occasionally been born with a sort of proboscis, and if any wild species of the same genus had naturally possessed a proboscis, it might have been argued that this had appeared as a monstrosity; but I have as yet failed to find, after diligent search, cases of monstrosities resembling normal structures in nearly allied forms, and these alone bear on the question. If monstrous forms of this kind ever do appear in a state of nature and are capable of reproduction (which is not always the case), as they occur rarely and singly, their preservation would depend on unusually favourable circumstances. They would, also, during the first and succeeding generations cross with the ordinary form, and thus their abnormal character would almost inevitably be lost." But, in a later edition of the *Origin of Species*, Darwin seems to contradict the above assertion: "It should not, however, be overlooked that certain rather strongly marked variations, which no one would rank as mere individual differences, frequently recur owing to a similar organisation being similarly acted on—of which fact numerous instances could be given with our domestic productions. In such cases,

if the varying individual did not actually transmit to its offspring its newly acquired character, it would undoubtedly transmit to them, as long as the existing conditions remained the same, a still stronger tendency to vary in the same manner. There can also be little doubt that the tendency to vary in the same manner has often been so strong that all the individuals of the same species have been similarly modified without the aid of any form of selection. Or only a third, fifth, or tenth part of the individuals may have been thus affected, of which fact several instances could be given. Thus Graba estimates that about one-fifth of the guillemots in the Faroe islands consist of a variety so well marked, that it was formerly ranked as a distinct species under the name *Uria lacrymans*. In cases of this kind, if the variation were of a beneficial nature, the original form would soon be supplanted by the modified form, through the survival of the fittest." Here we seem to have a plain statement of the origin of new forms by mutation.

Again, we read (page 34): "Some variations useful to him (*i.e.* man) have probably arisen suddenly, or by one step; many botanists, for instance, believe that the fuller's teasel, with its hooks, which cannot be rivalled by any mechanical contrivance, is only a variety of the wild Dipsacus; and this amount of change may have suddenly

arisen in a seedling. This is known to be the case with the turnspit dog."[1] But, as we have already said, Darwin at no time attached much importance to these jumps made by nature as a factor in evolution. He pinned his faith to the minute, indefinite variations which he believed could be piled up, one upon another, so that, if allowed sufficient time, either nature or the human breeder could, by a continued selection of these minute variations, call into being any kind of organism. The importance of selection, he writes, "consists in the great effect produced by the accumulation in one direction, during successive generations, of differences absolutely inappreciable by an uneducated eye" (page 36). On page 132 he writes: "I can see no limit to the amount of change, to the beauty and complexity of the coadaptations between all organic beings . . . which may have been effected[2] in the long course of time by nature's power of selection." He expressly states, on page 149, that he sees no reason to limit the process to the formation of genera alone.

Athough the theory of natural selection does not attempt to explain the causes of variation,

[1] This short-legged type of dog is sometimes seen among the ownerless and unselected pariah dogs of Indian towns; and a short-legged variety of the fowl may occur sporadically in Zanzibar, where the long-legged Malay is the prevalent breed.

[2] "Effected" appears in the earlier editions, but in the later editions has given place to "affected," probably a printer's error.

Darwin paid some attention to the subject. He believed that both internal and external causes contribute to variation, that variations tend to be inherited whether the result of causes within the organism or outside it. He believed that the inherited effect of use and disuse was a cause of variation, and cited, as examples, the lighter wing-bones and heavier leg-bones of the domestic duck and the drooping ears of some domestic animals. He supposed that animals showed a greater tendency to vary when under domestication than when in their natural state, attributing the supposed greater variability to the excess of food received, and the changed conditions of the life of domestic animals. Nevertheless, he was fully alive to the fact that "nearly similar variations sometimes arise under, as far as we can judge, dissimilar conditions; and, on the other hand, dissimilar variations arise under conditions which appear to be nearly uniform." In other words, the nature of organisms appeared to Darwin to be a more important factor in the origin of variations than external conditions. Evidence of this is afforded by the fact that some animals are more variable than others. Finally, he frankly admitted how great was his ignorance of the causes of variability. Variability is, he stated, governed by unknown laws which are infinitely complex.

It will be convenient to deal with each of

Darwin's main ideas on variation separately, and to consider to what extent they seem to require modification in the light of later research.

Firstly, Darwin believed that variations arise in what appears to be a haphazard manner, that they occur in all directions, and seem to be governed by the same laws as chance. It is our belief that we are now in a position to make more definite statements regarding variation than Darwin was able to.

Biologists can now assert definitely that variations do not always occur equally in all directions. The results of many years of the efforts of practical breeders demonstrate this. These men have not been able to produce a green horse, a pigeon with alternate black and white feathers in the tail, or a cat with a trunk, for the simple reason that the organisms upon which they operated do not happen to have varied in the required direction. It may perhaps be objected that breeders have no desire to produce such forms; had they wished to do so, they would probably have succeeded. To this objection we may reply that they have not managed to produce many organisms, which would be highly desirable from a breeder's point of view, as, for example, a blue rose, hens that lay brown eggs but do not become broody at certain seasons of the year, or a cat that cannot scratch.

As Mivart well says, on page 118 of his *Genesis of Species*, "Not only does it appear that there are

barriers which oppose change in certain directions, but that there are positive tendencies to development along certain special lines. In a bird which has been kept and studied like the pigeon, it is difficult to believe that any remarkable spontaneous variations would pass unnoticed by breeders, or that they would not have been attended to and developed by some fancier or other. On the hypothesis of indefinite variability, it is then hard to say why pigeons with bills like toucans, or with certain feathers lengthened like those of trogons, or those of birds of paradise, have never been produced."

There are certain lines along which variation seems never to occur. Take the case of the tail of a bird. Variable though this organ be, there are certain kinds of tail that are seen neither in wild species nor domesticated races. A caudal appendage, of which the feathers are alternately coloured, occurs neither in wild species nor in artificial breeds. For some reason or other, variations in this direction do not occur. Similarly, with the exception of one or two of the "Noddy" terns, whenever a bird has any of its tail feathers considerably longer than the others, it is always the outer pair or the middle pair that are so elongated. It would thus appear that variations in which the other feathers are especially lengthened do not usually occur. The fact that they are elongated in two or three wild species is the more signifi-

cant, because it shows that there is apparently nothing inimical to the welfare of a species in having, say, the third pair of tail feathers from the middle exceptionally prolonged.

This is a most important point, and one which seems to be ignored by the majority of scientific men, who appear to be misled by the boastful talk of certain successful breeders. Thus, on page 29 of the *Origin of Species*, Darwin quotes, with approval, Youatt's description of selection as "the magician's wand, by means of which he may summon into life whatever form and mould he pleases." Darwin further cites Sir John Sebright as saying, with regard to pigeons, that he would "produce any given feather in three years, but it would take him six years to obtain head and beak."

If it were possible absolutely to originate anything by selection, horticulturists would almost certainly ere this have produced a pure black flower. The fact that not a single mammal exists, either in nature or under domestication, with scarlet, blue, or green in its hair, appears to show that, for some reason or other, mammals never vary in any of these directions.

The fact that so few animals have developed prehensile tails seems to indicate that variation does not often occur in that direction, for obviously a prehensile tail is of the very greatest utility to its possessor; so that there can be

little room for doubt that it would be seized upon and preserved by natural selection, whenever it occurred.

As E. H. Aitken very truly says, "so early and useful an invention should, one would think, have been spread widely in after time; but there appears to be some difficulty in developing muscles at the thin end of a long tail, for the animals that have turned it into a grasping organ are few and are widely scattered. Examples are the chameleon among lizards, our own little harvest mouse, and, pre-eminent among all, the American monkeys" (*Strand Magazine*, Nov. 1908).

Even as there are many variations which seem never to occur in nature, so are there others which occur so frequently that they may be looked for in any species. Albinistic forms appear now and again in almost every species of mammal or bird; while melanistic sports, although not so common, are not by any means rare.

Every complete manual on poultry gives for each breed a note of the faults which constantly appear, and which the fancier has to watch carefully for and guard against. The fact that these "faults" occur so frequently in each breed shows how strong is the tendency to vary in certain definite directions. It is true that some of these faults are in the nature of reversions, as, for

example, the appearance of red hackles in the cocks of black breeds of poultry. On the other hand, some certainly are not reversions, such as the appearance of a white ring in the neck of the female of the Rouen duck, which should resemble the Mallard as regards the plumage of the neck. Again, the tendency of Buff Orpingtons to assume white in the wings and tail must be regarded as a variation which is not in the nature of a reversion. In short, the efforts of all breeders are largely directed to fighting against the tendencies which animals display towards variation in certain directions.

This tendency to vary in the direction of whiteness may account for many of the white markings which occur in nature, as, for example, the white tails of the Sea Eagle (*Haliaetus albicilla*) the Nicobar Pigeon (*Caloenas nicobarica*), and many hornbills. Provided that such variations are not too great a handicap to their possessors in the struggle for existence, natural selection will allow them to persist.

It was the belief of Linnæus, based on experience, that every blue or red-coloured flower is likely to produce a white variety, hence he held that it is not safe to trust to colour for the identification of a botanical species.

On the other hand, white flowers are not likely to produce red varieties, and we believe we may positively assert that they never produce a blue

sport. Similarly, white animals appear not to give rise to colour varieties.

We are never surprised to find that an ordinary upright plant produces as a sport or mutation a pendulous, or fastigiate form. These aberrant varieties, be it noted, occur in species which belong to quite different orders.

De Vries points out that laciniated leaves appear in such widely separated trees and shrubs as the walnut, the beech, the hazel-nut, and the turnip.

Another example of the definiteness of variation is furnished by what Grant Allen calls the "Law of Progressive Colouration" of flowers.

On pp. 20, 21 of *The Colours of Flowers*, he writes, "All flowers, as we know, easily sport a little in colour. But the question is, do their changes tend to follow any regular and definite order? Is there any reason to believe that the modification runs from any one colour toward any other? Apparently there is. . . . All flowers, it would seem, were in their earliest form yellow; then some of them became white; after that a few of them grew to be red or purple; and finally a comparatively small number acquired the various shades of lilac, mauve, violet, or blue."

So among animals there are many colour patterns and structures that appear in widely different genera, as, for example, the magpie

colouring in birds. With this phenomenon we shall deal more fully when speaking of animal colouration. There is certainly no small amount of evidence which seems to indicate that, from some cause or other, an impetus has been given to certain organs to develop along definite lines, The reduction of the number of digits in several mammalian families which are not nearly related is a case in point. This phenomenon is, as Cope points out, observed in Marsupials, Rodents, Insectivores, Carnivores, and Ungulates. He, being a Lamarckian, ascribes this to the inherited effects of use. Wallaceians attribute it solely to the action of natural selection. The assumption of a growth-force or tendency for the development of one digit at the expense of the others, would explain the phenomenon equally well. And it is significant that many palæontologists are believers in some kind of a growth-force. In the case of certain extinct animals we seem to have examples of the over-development of organs. "Palæontology," writes Kellog on p. 275 of his *Darwinism To-day*, "reveals to us the one-time existence of animals, of groups of animals, and of lines of descent, which have had characteristics which led to extinction. The unwieldiness of the giant Cretaceous reptiles, the fixed habit of life of the crinoids, the coiling of the ammonities and the nautili, the gigantic antlers of the Irish stag—all these are examples

of development along disadvantageous lines, or to disadvantageous degrees. The statistical studies of variation have made known numerous cases where the slight, as yet non-significant (in a life-and-death struggle) variation in pattern of insects, in dimensions of parts, in relative proportions of superficial non-active areas, are not fortuitous, that is, do not occur scattered evenly about a mean or mode according to the law of error, but show an obvious and consistent tendency to occur along certain lines, to accumulate in certain directions."

It seems to us that the only proper attitude to adopt in the present state of our knowledge is, not to call in to our aid an unknown growth-force, but simply to say that there is evidence to show that variations frequently occur along certain definite lines only.

Darwin's second assumption was that there is no limit to which variations may be accumulated in any direction; that by adding one minute variation to another through countless generations new species, new genera, new families may arise. This assumption, if applied to continuous or fluctuating variations, seems opposed to facts. All the evidence available goes to show that there is a definite limit to which minute variations can be accumulated in any given direction. No one has succeeded in breeding a dog as large as a horse, or a pigeon with a beak as long as that

of a snipe. In the case of racehorses, which have been selected so carefully through a long period of time, we seem to have reached the limit of speed which can be attained by the multiplication of insignificant variations. We do not wish to dogmatise, but we believe that of late years there has not been any material increase in the speed of our racehorses.

Mr S. Sidney says, on page 174 of *Cassell's Book of the Horse*: "As far as form went (*pace* Admiral Rous), the British racehorse had reached perfection in 1770, when 'Eclipse' was six years old." He quotes the measurements of the skeleton of "Eclipse" in the Museum of the Royal College of Surgeons as evidence of this. All the efforts of breeders, then, have failed appreciably to improve the form of the British racehorse in the course of over a century and a quarter.

De Vries has made some important experiments with a view to determining whether or not there is a limit to the amount of change which can be induced by the selection of fluctuating or continuous variations as opposed to mutations. "I accidentally found," he writes, on page 345 of *Species and Varieties: their Origin by Mutation*, "two individuals of the 'five-leaved' race (of clover); by transplanting them into my garden I have isolated them and kept them free from cross-fertilisation with the

ordinary type. Moreover, I brought them under such conditions as are necessary for the full development of their character; and last, but not least, I have tried to improve their character as far as possible by a very rigid and careful selection. . . . By this method I brought my strain within two years up to an average of nearly 90 per cent. of the seedlings with a divided primary leaf (such seedlings averaging five leaves in the adult). . . . This condition was reached by the sixth generation in the year 1894, and has since proved to be the limit, the figures remaining practically the same through all the succeeding generations. . . . I have cultivated a new generation of this race nearly every year since 1894, using always the strictest selection. This has led to a uniform type, but has not been adequate to produce further improvement." Similarly, De Vries found in the bulbous buttercup (*Ranunculus bulbosus*) a strain varying largely in the number of petals; therefore he tried by means of continuous selection of those flowers having the largest number of petals to produce a double flower, but was not able to do so. He succeeded in evolving a strain with an average number of nine petals, some individuals having as many as twenty or thirty; but even by breeding only from these last he could not increase the average number of petals in any

generation beyond nine. This was the limit to be obtained by the most rigorous selection of fluctuating variations.

Selection, based on fluctuating variation, does not, asserts De Vries, conduce to the production of improved races. "Only temporary ameliorations are obtained, and the selection must be made in the same manner every year. Moreover, the improvement is very limited, and does not give any promise of further increase." Notwithstanding prolonged efforts, horticulturists have not yet succeeded in breeding a biennial race of either beetroots or carrots that does not continually give rise to useless annual forms. Writing of the beet, De Vries says useless annual varieties "are sure to return each year. They are ineradicable. Every individual is in the possession of this latent quality, and liable to convert it into activity as soon as the circumstances provoke its appearance, as is proved by the increase of annuals in the early sowings"—that is to say, in circumstances favourable to the annual variety.

It will be urged perhaps that these experiments, which seem to show that there is a limit to which a species can be modified by the accumulation of fluctuating variations, cannot have been properly carried out, because all the various breeds of pigeons and other domestic animals clearly show that extraordinary differ-

ences not only can, but have actually been produced by the selection of such variations. This objection is based upon the assumption that breeders have in the past dealt only with fluctuating variations. This assumption does not appear to be justified. It is exceedingly probable that most, if not all, the varieties of domesticated animals have originated in mutations. Take, for instance, the modern turbit pigeon; this has been derived from the old Court-bec, described and figured over two centuries ago by Aldrovandus.

De Vries goes so far as to assert that the various races of pears are all mutations; that each distinct flavour is a mutation, and that it is impossible to produce a new flavour by selecting fluctuating variations. Thus it would appear that in every case of the production of a new breed a mutation has occurred which has attracted the fancy of some breeder, and he has seized upon this and perpetuated it.

All the evidence available tends to show that there is a limit — and one which is quickly reached—to the amount of change that can be produced by the selection of fluctuating or continuous variations. We, therefore, seem driven to the belief that evolution is based on the kind of variation which Professor Bateson terms "discontinuous variation" and Professor De Vries calls "mutation."

Bateson on Variation

As long ago as 1894 Bateson published his *Materials for the Study of Variation*, in which he set forth a large number of cases of discontinuous variation which he had collected. He pointed out that species are discontinuous, that they are sharply separated one from another, whereas "environments often shade into one another and form a continuous series." How, then, he asked, if variations are minute and continuous, have these discontinuous species arisen? May not variation prove to be discontinuous, and thus make it clear why species are discontinuous?

On page 15 of the above-cited work we find: "The preliminary question, then, of the degree of continuity with which the process of evolution occurs has never been decided. In the absence of such a decision, there has nevertheless been a common assumption, either tacit or expressed, that the process is a continuous one. The immense consequence of a knowledge of the truth as to this will appear from a consideration of the gratuitous difficulties which have been introduced by this assumption. Chief among these is the difficulty which has been raised in connection with the building up of new organs in their initial and imperfect stages, the mode of transformation of organs, and, generally, the selection and perpetuation of minute variations. Assuming, then, that variations are minute, we are met by this familiar difficulty. We know

that certain devices and mechanisms are useful to their possessors; but from our knowledge of natural history we are led to think that their usefulness is consequent on the degree of perfection in which they exist, and that if they were at all imperfect, they would not be useful. Now it is clear that in any continuous process of evolution such stages of imperfection must occur, and the objection has been raised that natural selection cannot protect such imperfect mechanisms so as to lift them into perfection. Of the objections which have been brought against the theory of natural selection this is by far the most serious."

Bateson further pointed out that chemical compounds are not continuous, that they do not merge gradually each into the next, and suggested that we might expect a similar phenomenon in the organic world.

Elsewhere he says: "Let the believer in the efficacy of selection operating on continuous fluctuations try to breed a white or a black rat from a pure strain of black-and-white rats, by choosing for breeding the whitest or the blackest; or to raise a dwarf sweet pea from a tall race by choosing the shortest. It will not work. Variation leads and selection follows."

But Bateson's views fell upon stony ground, because zoologists are mostly men of theory and not practical breeders. They laboured under the

delusion that mutations or "sports" are rare in nature, and that when these do happen to occur they must of necessity be swamped by intercrossing.

However, the discovery of the Abbé Mendel's account of his experiments on breeding mongrel sweet peas has opened the eyes of many zoologists, so that they have at last learned what practical breeders have known for untold years—namely, that sports have a way of perpetuating themselves. Moreover, Mendel was able to give a theoretical explanation of his discoveries, with the result that the believers in discontinuous variation have largely increased in number of late.

While we are unable to see eye to eye with Professor Bateson in all things, we gladly recognise the immense value of his work. Had his statements in 1894 received the attention they merited, zoological theory would to-day be considerably more advanced than it actually is.

Professor De Vries has gone farther than Bateson, having engrafted upon the Darwinian hypothesis the theory of mutations. He has done no small amount of experimental work, and has undoubtedly thrown much new light on the ways in which species arise. He is purely a botanist, so that he argues only from plants. Nevertheless, we believe that some of his conclusions are applicable to animals. We are far

from accepting his theory of mutations *in toto*. We are, however, convinced that he, like Bateson, is on the right track. There can be no doubt that a great many new forms have originated suddenly, by jumps, and not by imperceptibly slow degrees. Before giving a list of the names of some of the races, both plant and animal, which appear to have come into existence suddenly, it will be of advantage to consider for a little some of the more important conceptions of De Vries.

That eminent botanist, as we have already seen, insists on the distinction between fluctuating variations and mutations. The former correspond, for all practical purposes, to the continuous variations of Bateson, and the latter seem to be equivalent to his discontinuous variations.

According to De Vries, all plants display fluctuating variation, but only a small percentage exhibit the phenomenon of mutation. The most daring of his conceptions is, that the history of every species is made up of alternating periods of inactivity, when only fluctuating variations occur, and of activity when "swarms of species" are produced by mutation, and of these only a few at the most survive; natural selection, which De Vries likens to a sieve, determining which shall live and which shall perish.

Varieties and Elementary Species

As we have seen, De Vries does not believe that new species can arise by the accumulation of fluctuating variations. By means of these the race may be greatly improved, but nothing more can be accomplished. These variations follow Quetelet's law, which says that, for biological phenomena, deviations from the average comply with the same laws as the deviations from the average in any other case, if ruled by chance alone.

Very different in character are mutations. By means of these, new forms, quite unlike the parent species, suddenly spring into being. Mutations are said by De Vries to be of two kinds—those that produce varieties and those which result in new elementary species.

According to De Vries, those species of plants which are in a state of mutation (he refers to the species of the systematic botanists) are of a composite nature, being made up of a collection of varieties and elementary species. His conception of a variety is a plant that differs from the parent plant in the loss or suppression of one or more characters, while an elementary species differs from the parent form in the possession of some new and additional character. But we will allow him to speak for himself: "We can consider (page 141 *Species and Varieties*) the following as the principal difference between elementary species and varieties: that the first arise by the

acquisition of entirely new characters, and the latter by the loss of existing qualities, or by the gain of such peculiarities as may already be seen in other allied species. If we suppose elementary species and varieties originated by sudden leaps and bounds, or mutations, then the elementary species have mutated in the line of progression, some varieties have mutated in the line of retrogression, while others have diverged from the parental types in a line of digression or in the way of repetition. . . . The system (of the vegetable kingdom) is built up of species; varieties are only local and lateral, never of real importance for the whole structure."

De Vries asserts that these elementary species, when once they arise, breed true, and show little or no tendency to revert to the ancestral form. We can, says De Vries, ascertain only by experiment which plants are in the mutating state and which are not. The great majority, however, are not at present in the mutating state.

The distinction between fluctuating variation and mutation has been roughly illustrated by the case of a solid block of wood having a number of facets, on one of which it stands. If the block be tilted slightly it will, when the force that has tilted it is removed, return to its old position. Such a gentle tilt may be compared to a fluctuating variation in an organism. If, however, the block be tilted to such an angle that when left to

itself the block does not return to its old position, but tips over and comes to rest on another facet, we have a representation of the kind of change indicated by a mutation.

The analogy is far from perfect, for it makes it appear that the smallest mutation must of necessity involve a departure from the normal type more considerable than that of the largest fluctuating variation. Now, although mutations ordinarily consist in considerable deviations from the mean or mode of the type, while continuous variations are usually minute deviations, it sometimes happens that the extreme fluctuations are more considerable than some mutations. Hence "fluctuating" describes this latter kind of variation more accurately than "continuous" does.

The test, then, of a mutation is not so much the amount of deviation as the degree in which it is inherited. Mutations show no tendency to a gradual return to the mean of the parent species; fluctuating variations do display such a tendency. A mutation consists, as M. E. East says, in the production of a new mode or centre for linear fluctuation; it is, as it were, a shifting of the centre of gravity; the centre about which those fluctuations which we call continuous variations occur.

As it is of considerable importance thoroughly to grasp the true nature of mutations or discon-

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tinuous variations, and as some writers do not appear to realise wherein lies the essential difference between the two kinds of variation, we will, at the risk of appearing tedious, give a further illustration. Let A be a species of bird of which the average length of the wing is 20 inches, and let us suppose that individuals belonging to that species occur in which the length of the wing varies as much as 3 inches each side of the mean ; thus it is possible to find individuals of this species with a wing as short as 17 inches, or as long as 23 inches. Let B be another species of which the average length of the wing is 17 inches, and let us suppose that a 3-inch variation on each side of the mean be found to occur. Individuals belonging to species B will occur which have a wing as short as 14 inches, or as long as 20 inches. Thus some individuals of the short-winged species will have longer wings than certain individuals of the long-winged species. Similarly, certain individuals of a species which display a mutation may show less deviation from the mean than some individuals showing a very pronounced fluctuating variation. In other words, even as by measuring the length of wing in the above example it was not always possible to say whether a given individual belonged to species A or B, so is it not always possible to say by looking at an individual that shows a considerable departure from the

mean whether that departure is due to a mutation or a fluctuating variation.

It is only by watching the effect of the peculiarity on the offspring of its possessor that we are able to determine the nature of the variation. Where the peculiarity is due to a fluctuating variation the offspring will display the peculiarity in a diminished degree ; but if the peculiarity be due to a mutation, the offspring are likely to display it in as marked a degree as the parent.

Fritz Müller and Galton conducted independently enquiries into the amount of the regression shown by the progeny of parents which have deviated from the average by fluctuating variation.

Müller experimented with Indian corn; Galton with the sweet pea.

Each found that where the deviation of the parents is represented by the figure 5, that of their offspring is usually 2, that is to say, the deviation they display is, on the average, less than half that of their parents.

Applying this rule to the hypothetical case given above, if two individuals of species A having a length of wing of 20 inches be bred together, their offspring will, on an average, have a length of wing of 20 inches, since neither parents showed any deviation from the mean. On the other hand, the offspring of 20-inch-wing individuals of species B would show, on an

average, a length of wing of only about 18¼ inches. They tend to return to that mode from which their parents had departed.

But suppose that the deviation of the parents in this case had been due, not to fluctuating variation, but to a mutation; this would mean that, owing to some internal change in the egg that produced each parent, 20 inches became the normal length of wing; that the normal length of wing had suddenly shifted from 17 inches to 20 inches.

The result of this would be that their offspring would have on an average a wing-length of 20 inches instead of 18¼ inches, that the centre of variation as regards length of wing had suddenly shifted from 17 to 20, that, in future, all fluctuating variations would occur on either side of 20 inches, instead of on either side of 17 inches as heretofore.

Thus a variation is a fluctuating one or a mutation according as it does or does not obey Galton's Law of Regression.

De Vries says that it is of the essence of mutations that they are completely inherited. This statement, although substantially true, fails to take into consideration the factor of fluctuating variation. For example, in the above instance if the two individuals of species B had mutated into forms with a 20-inch wing, their offspring will nevertheless vary *inter se*, some of them

will have wings shorter than 20 inches and others wings more than 20 inches in length. But the average wing-length of the offspring of the two mutating individuals will be 20 inches.

So much, then, for the practical difference between a mutation and a fluctuating variation. In Chapter V. we shall discuss the possible causes of the difference. By way of anticipation we may say that the suggestion we shall make is that a mutation is due to some rearrangement in the particles which represent that part of the organism in the fertilised egg, whereas a fluctuating variation is caused by variations in the particles themselves.

De Vries, it should be noted, bases his theory largely on experimental evidence. His dictum is "the origin of species is an object of experimental observation." He has, we consider, proved conclusively that among plants mutations sometimes occur, and, further, that in a mutating plant the same mutation tends to occur again and again. This latter is a most important fact, because it goes some way towards overcoming the difficulty urged by Darwin that isolated sports must be swamped by continual crossing with the normal type. If mutations arise in swarms, as De Vries asserts they do, then any particular mutation is likely, sooner or later, to cross with a similar mutation and so be able to perpetuate itself.

The classical example of a mutating plant is the evening primrose of the species *Oenothera lamarckiana.* This is described by De Vries as a stately plant, with a stout stem, attaining often a height of 1.6 metres or more. The flowers are large and of a bright yellow colour, attracting immediate attention, even from a distance. "This striking species," he writes, in *Species and Varieties* (p. 525), "was found in a locality near Hilversum, in the vicinity of Amsterdam, where it grew in some thousands of individuals. Ordinarily biennial, it produces rosettes in the first, and stems in the second year. Both the stems and the rosettes were seen to be highly variable, and soon distinct varieties could be distinguished among them.

The first discovery of this locality was made in 1886. Afterwards I visited it many times, often weekly or even daily, and always at least once a year up to the present time. This stately plant showed the long-sought peculiarity of producing a number of new species every year. Some of them were observed directly in the field, either as stems or rosettes. The latter could be transplanted into my garden for further observation, and the stems yielded seeds to be sown under like control. Others were too weak to live a sufficiently long time in the field. They were discovered by sowing seed from indifferent plants of the wild locality in the garden. A third

and last method of getting still more new species from the original strain was the repetition of the sowing process, by saving and sowing the seed which ripened on the introduced plants. These various methods have led to the discovery of over a dozen new types, never previously observed or described." Some of these De Vries regards as varieties, in the sense in which he uses the words; others, he maintains, are real progressive species, some of which are strong and healthy, others weaker and apparently not destined to be successful. All these types proved absolutely constant from seed. "Hundreds of thousands of seedlings may have arisen, but they always come true and never revert to the original *O. lamarckiana* type. But some of them, however, are, like their parent form, liable to mutations." The case of the evening primrose is by no means an isolated one. De Vries cites several other instances of plants in a mutating state. "The common poppy," he says (p. 189), "varies in height, in colour of foliage and flowers; the last are often double or laciniated. It may have white or bluish seeds, the capsules may open themselves or remain closed, and so on. But every single variety is absolutely constant, and never runs into another when the flowers are artificially pollinated and the visits of insects excluded." Similarly the garden carnation sometimes gives rise to the wheat-ear form. "In this

variety," writes De Vries (p. 228), "the flower is suppressed, and the loss is attended by a corresponding increase in the number of pairs of bracts. This malformation results in square spikes, or somewhat elongated heads, consisting only of the greenish bracts. As there are no flowers, the variety is quite sterile, and, as it is not regarded by horticulturists as an improvement on the ordinary bright carnations, it is seldom multiplied by layering. Notwithstanding this it appears from time to time, and has been seen in different countries and at different periods, and what is of great importance for us, in different strains of carnations. Though sterile, and obviously dying out as often as it springs into existence, it is nearly two centuries old. It was described in the beginning of the eighteenth century by Volckamer, and afterwards by Jaeger, De Candolle, Weber, Masters, Magnus, and many other botanists. I have had it twice at different times and from different growers." Similarly, the long-headed green dahlia arose twice over some years ago in the nursery of Messrs Zocher & Co.

Further, the peloric Toad-flax (*Linaria vulgaris peloria*) is, De Vries informs us, "known to have originated from the ordinary type at different times and in different countries under more or less divergent conditions." And, as this variety is wholly barren, it must in each instance have had an independent origin. Lastly, the

purple beech seems to be a mutation which has originated at least three times over.

Every one interested in biological theory should read both *Species and Varieties* and *Plant Breeding* by De Vries, works which are of incalculable value to the horticulturist and agriculturist as well as to the biologist.

While not wishing to detract in any way from the truly splendid work done by De Vries, we feel constrained to bring several charges against him.

Firstly, he suffers from the complaint that seizes nine out of ten originators of new theories. He pushes his theory to extreme lengths; he allows his imagination to run away with him. We do not think that on the evidence available he is justified in asserting that every species passes through alternating periods of comparative quiescence and periods in which it throws off, as mutations, swarms of elementary species. He is justified in asserting that discontinuous variation is by no means an uncommon phenomenon, but further than this it does not seem safe to go at present.

Secondly, he ought to lay more stress on the fact that *Oenothera lamarckiana* is a plant which does not appear to be known in the wild state, and that it is therefore possibly a hybrid plant, and the so-called elementary species which it gives off may be merely the varieties out of

which it has been built up. Boulenger and Bailey have both studied this plant, and they have not been able to witness all the mutations of which De Vries speaks, so that the former says, "The fact that *Oenothera lamarckiana* was originally described from a garden flower, grown in the Paris *Jardin des Plantes*, and that, in spite of diligent search, it has not been discovered wild anywhere in America, favours the probability that it was produced by crossing various forms of the polymorphic *Oenothera biennis*, which had been previously introduced in Europe."

It has further been objected that, even if these various forms which Lamarck's evening primrose throws off are true mutations, they ought not to be called new species, for they do not differ sufficiently from the parent species to deserve the name of new species. The reply to this criticism is that De Vries asserts that mutations produce new elementary species, which are not the same things as new species in the ordinary sense of the term. Most Linnæan species differ from one another to a far greater extent than do elementary species. It seems to us quite plain that new species arise, not by a single mutation, but by two or three successive mutations which occur in various parts of an organism.

First arises a well-marked variety, by a single mutation. Subsequent mutations follow, so that

a distinct race is produced. And, finally, fresh mutations occur, so that a new species is eventually produced.

What De Vries calls an elementary species the majority of systematists would call a well-marked variety.

We may take this opportunity of remarking that the definition of a species is one on which naturalists seem unable to agree.

So vast is the field of biology, that now-a-days biologists are compelled to specialise to some extent. Thus we have botanists, ornithologists, those who devote themselves to the study of mammals, those who confine themselves to reptiles, or insects, or fishes, or crustaceans, or bacteria, etc.

Now each class of systematists has its own particular criterion of what constitutes a species. Ornithologists do not seem very exacting. Most of them appear to consider a constant difference of colour sufficient for the formation into a species of the birds that display such a variation. Those who study reptiles, on the other hand, do not allow that a mere difference in colour is sufficient to promote its possessor to specific rank. Into these nice questions we cannot enter. For our purpose a species is a group of individuals that differ from all other individuals in displaying certain well-marked and tolerably constant characters, which they transmit to their offspring.

Our contention, then, is that new species, in the ordinarily-accepted use of the term, do not arise as a rule by one sudden bound (although they may sometimes do so), but are the result of the accumulation of several mutations or discontinuous variations. Some of these mutations are exceedingly well marked, while others are so small as to be indistinguishable from the more extreme fluctuating variations. Before passing on to consider some cases of well-marked mutations which have occurred among animals and plants, we should like to take this opportunity of pointing out that as regards experiments in evolution the botanist is far more favourably situated than the zoologist.

The botanist is able to reproduce many species vegetatively, *e.g.* by cuttings, and is thus easily able to multiply examples of mutation. He can also reproduce the great majority of plants by self-fertilisation, and so experiences no difficulty in "fixing" a new form. Again, plants are far easier to control than animals; as a rule they can be transplanted without any impairment of their capacity for breeding. Moreover, they produce a greater number of offspring than the most prolific of the higher animals. The animal breeder is thus at an obvious disadvantage as compared with the horticulturist. It is only with great difficulty that he can fix the mutations which appear in his stock.

"Scatliff Strain" of Turbit

The history of the production of the "Scatliff strain" of turbit affords a good example of the kind of difficulties that confront the breeder.

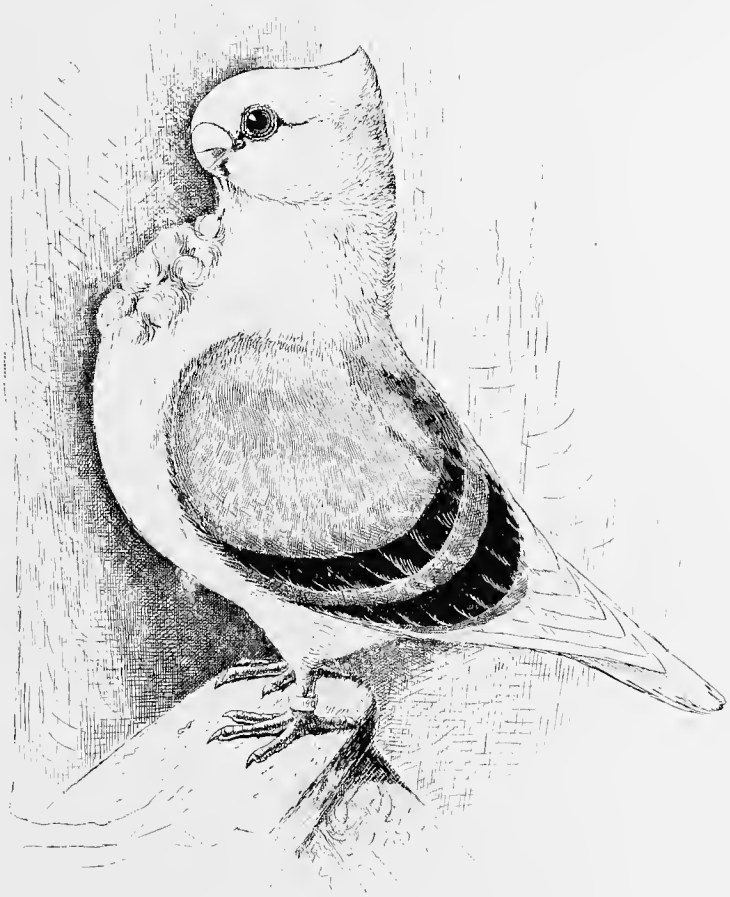
Pigeon fanciers require that the ideal turbit shall have, among other things, an unbroken "sweep," that is to say the line of the profile from the tip of the beak to the back of the head should be the arc of a circle. As a rule this line is broken by the overgrowth of the wattle at the base of the beak. Mr Scatliff, however, has succeeded in breeding a strain which possesses the required description of profile.

"In the year 1895," writes Mr H. P. Scatliff on page 25 of *The Modern Turbit*, "I visited Mr Houghton's lofts and purchased three or four extra stout and short-beaked stock birds. . . . The following year I mated one of these to one of my own black hens, and reared one of the most successful show birds ever bred, viz. 'Champion Ladybird,' a black hen. . . . Most of the leading judges and many turbit breeders remarked upon this hen's wonderful profile, which seemed to improve as she got older instead of getting worse, as is usual in rather coarse-wattled birds. I, too, had remarked this, and it opened my eyes to a point in turbit breeding which I had never heard mentioned by any turbit judges or breeders, and which I believe I am now pointing out for the first time in print, viz. that the feathers over her beak wattle which formed

her front *grew from the top and right to the front of her wattle, and not from slightly behind*, as in almost every other turbit of her day; thus, as the wattle developed and grew coarser, the front became more developed, and made her head larger without in any way spoiling the sweep of the profile.

"The same year 'Ladybird' was bred I bred eight others from the same pair, and with one exception all turned out to be hens. There was only one other hen, however (a dun), that had this same point, but in a lesser degree than 'Ladybird,' and from these two hens nearly all my blacks, and several of my blues are descended."

Mr Scatliff, having "spotted" this point, looked about him for another bird having the peculiarity, with the object, if possible, of fixing the same in his strain. He discovered this point in a pigeon belonging to Mr Johnston of Hull, and purchased the bird for £20. But it died in the following spring without producing for Mr Scatliff a single young one. The next year Scatliff found that a bird belonging to a Mr Brannam had the required peculiarity and so purchased him for £20. But that cock, too, died before anything was bred from him. Nothing daunted, Scatliff found that another of Brannam's cocks displayed the same peculiarity, so purchased him in 1899 for £15, but he also died before the



A TURBIT BELONGING TO MR. H. P. SCATLIFF
From "The Modern Turbit," published by "The Feathered World," London.

year was out. Meanwhile Scatliff had, by mating up "Ladybird" with the most likely of his own cocks, succeeded in producing one or two young cocks with the desired point. By breeding these with their mother "Ladybird" and their offspring again with "Ladybird," Scatliff eventually succeeded in breeding some turbits, both blacks and duns, with the required peculiarity fully developed, but not before he had spent a further sum of £55 on two other cocks, both of which died before they could be mated with the famous "Ladybird." However, amid all his misfortunes, Scatliff informs us that he bought one bird, by name "Amazement," which did assist him in fixing his strain. Thus Scatliff spent considerably over £100 in purchases, and took eight years fixing the peculiarity in question. Had "Ladybird" been a flower, the peculiarity could probably have been fixed in one generation by self-fertilisation.

This furnishes an excellent example of the trouble which breeders will take, and the expense to which they will go in order to produce a desired result. Nevertheless, it appears to be the fashion for scientific men to decry the work of the breeder.

Let us now pass on to consider the cases of mutations which are known to have occurred among animals.

Mutations among Animals

Some instances of great and sudden variation in domesticated animals have become classical, and been detailed in almost every work on evolution. These are, firstly, the celebrated hornless Paraguay cattle. This hornless breed, or rather the ancestor of the breed, arose quite suddenly.

Many domestic horned breeds of animals, especially sheep and goats, throw off hornless sports. Were a hornless breed of buffalo found in nature, it would undoubtedly be ranked a new species, and the Wallaceians would doubtless exercise much ingenuity in explaining how natural selection had brought about the gradual disappearance of the horns ; and palæontologists, being baffled in their search for intermediaries between the hornless species and their horned ancestors, would complain of the imperfection of the geological record.

It may, perhaps, be argued that this hornless mutation was a direct result of the unnatural conditions to which the Paraguay cattle were subjected, it may be asserted that since there are no species of hornless cattle in nature, such mutations have never occurred under natural conditions, and hence the Paraguay cattle prove nothing. As a matter of fact, we know that in nature a great many mutations occur which are

not perpetuated because not beneficial to the species. A hornless individual in the wild state would stand but little chance in fighting for females against his horned brethren. We must keep clearly in mind that the theory of mutation does not seek to abolish natural selection; it merely affords that force something substantial to work upon.

The second classical example of a leap taken by nature is furnished by the Franqueiro breed of long-horned cattle in Brazil. These furnish us with an example of a mutation in the other direction. Then there is the Niata or bull-dog breed of cattle, which are also South American. These instances would seem to indicate that cattle are what De Vries would call "in a mutating state" in that part of the world.

The other classical examples of great and sudden variations are the Ancon sheep of Massachusetts, the Mauchamp breed of Merino sheep, the tufted turkeys, and the long-haired race of guinea-pigs.

The "wonder horses," whose manes and tails grow to an extraordinary length, so as to trail on the ground, may perhaps be cited as a race which originated in a sudden mutation. They are all descendants of a single individual, Linus I., whose mane and tail were respectively eighteen and twenty-one feet long. But in this case it is important to note that the parents and

grandparents of Linus I. had exceptionally long hair.

Coming now to birds we find several undoubted examples of mutations, or new forms which have come suddenly into being.

The black-winged peafowl, whose peculiarities were commented on by Darwin, afford a striking example of this phenomenon. These birds breed true when mated together, and are known to have arisen from common peafowl in no less than nine instances. The cocks have the wings (except the primary quills), black glossed with blue and green, and have the thighs black, whereas, in the ordinary peacock, the same part of the wing is nearly all mottled black and pale buff, and the thighs are drab. The black-winged hen, on the other hand, is nearly white, but has a black tail and black speckling on the upper surface of the body, while her primary quills are cinnamon coloured as in male peafowl, not drab as in the normal hens. The young are white when hatched, the young cock gradually assuming the dark colour as he matures.

This mutation, which, in one case quoted by Darwin, increased among a flock of peafowl until the black-winged supplanted the ordinary kind, is so distinct in appearance in all stages that it was formerly supposed to be a true species (*Pavo nigripennis*), of which the wild habitat was unknown.

The Golden Pheasant (*Chrysolophus pictus*) produces, in domestication, the dark-throated form (*C. obscurus*), in which the cock has the throat sooty-black instead of buff, and the scapulars or shoulder feathers black instead of red. Moreover, the two middle-tail-feathers are barred with black and brown like the lateral ones, while in the ordinary form they are spotted with brown on a black ground. The hens have a chocolate-brown ground-colour instead of yellow-ochre as in the normal type. The chicks are likewise darker.

The common duck, in domestication, when coloured like the wild mallard, sometimes produces a form in which the chocolate breast and white collar of the drake are absent, the pencilled grey of the abdomen reaching up to the green neck. In this mutation the duck has the head uniformly speckled black and brown, and lacks the light eye-brow and cheek-stripes found in the normal duck. Both sexes have the bar on the wing dull black instead of metallic blue.

The ducklings which ultimately bear this plumage are sooty-black throughout, not black and yellow like normal ones.

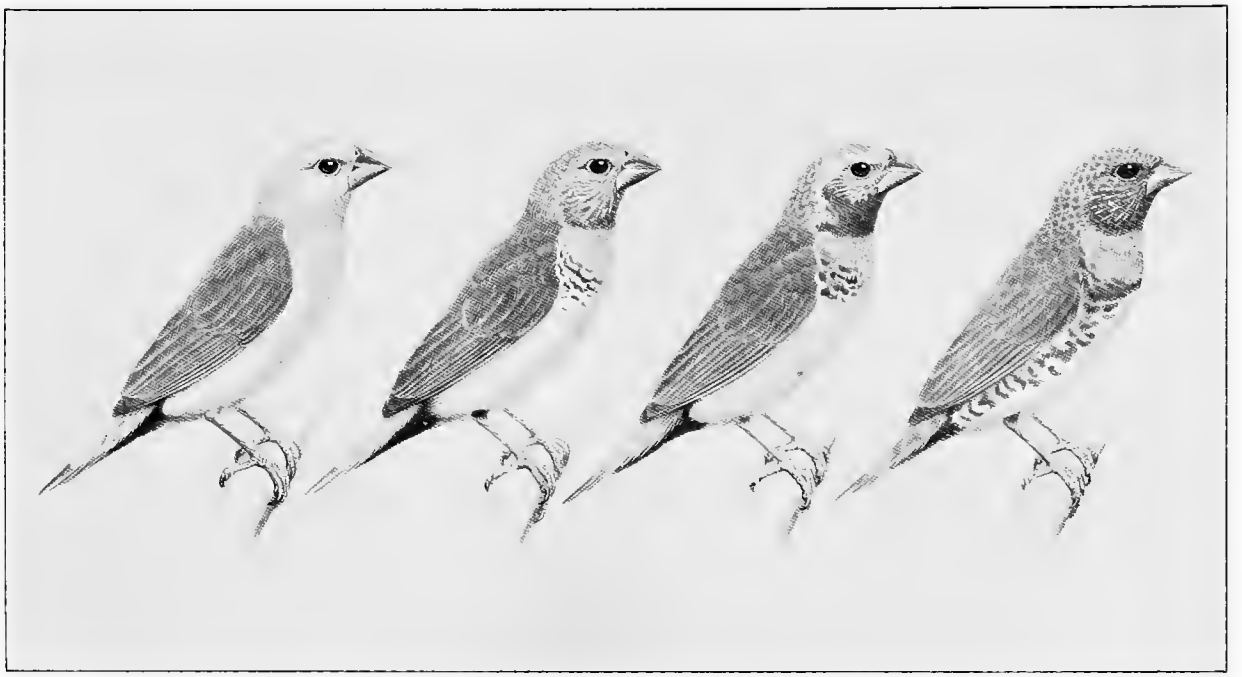
The phenomenon of mutation is not confined to animals in a state of domestication. The common Little Owl of Europe (*Athene noctua*) has produced the mutation *A. chiaradiæ* in the wild state. In this the irides are dark, instead of

yellow as in the normal type, and the plumage of the back of the wings is longitudinally streaked with white instead of barred. Several examples of this form were found, along with normal young, in the nest of one particular pair of little owls in Italy, but the whole family were foolishly exterminated by local ornithologists.

The reed bunting (*Emberiza schoeniclus*) exists in two distinct forms—one having a much stouter bill than the other (*E. pyrrhuloides*). This probably is an example of a mutation.

The rare yellow-rumped Finch (*Munia flaviprymna*), of Australia, has displayed a tendency to change into the allied and far commoner chestnut-breasted Finch (*M. castaneithorax*) during the lifetime of the individual (*Avicultural Magazine*, 1907). Conversely, the male of the common Red-billed Weaver (*Quelea quelea*) of Africa has been found in its old age to assume the characters of the comparatively rare *Q. russi*, its black throat becoming pale buff as in that form.

Everyone is familiar with the chequered variety of the common blue-rock pigeon, in which the wings are regularly mottled with black instead of being barred. This form sometimes occurs among wild birds, so that it has been described as a distinct species. It is important to note that there are red, dun, and silver chequers as well as blue ones.



By permission of the Avicultural Society

YELLOW-RUMPED AND CHESTNUT-BREASTED FINCHES, WITH SPECIMENS IN TRANSITIONAL STATE
On the left, the yellow-rumped finch; on the right, the chestnut-breasted; birds in state of change in the middle.

Mutations among Birds

A well-marked mutation which appears regularly in nature is the red-headed variety of the beautiful Gouldian Finch (*Pöephila mirabilis*) of North Australia. Normally the head of the cock is black, but in about ten per cent. of the individuals the cock has a crimson head, while that of the hen is dull crimson and black.

Mutations which occur with such regularity are certainly rare. On the other hand, there are certain mutations which we may expect to see appear in any species of plant or animal.

Albinistic forms are a case in point, and less frequently we see white varieties which are not pure albinos, because the eye retains some at least of the normal pigment. As examples, we may cite white dogs, cats, fowls, horses, ducks, geese, and Java sparrows among domesticated animals, and the white forms of the Amazonian dolphin and of the giant Petrel of the South seas (*Ossifraga gigantea*) among wild creatures.

In a white mutation the eye may lose all its pigment, and then we have a true albino. Such forms on account of their imperfect vision cannot survive in a state of nature, hence no wild pink-eyed species are known.

Or the eye may display a partial loss of pigment, as, for example, in the white domestic forms of the common goose, the Chinese goose, and the Muscovy duck. Finn saw a case in which the eyes of a pink-eyed rabbit changed

after death into this type of eye—that is, with the pupil black and the iris blue. It is to be observed that this kind of eye sometimes occurs in coloured horses, rabbits, and dogs. Finally, we have white mutations in which the eye loses none of the pigment. These are abundant in nature, and probably most of the white species of birds—as, for example, some egrets, swans, etc.—arose in this way.[1] Pure white species are comparatively uncommon in nature, because, except in snow-clad regions, white creatures are easily seen by their adversaries. Most white birds are of considerable size, and well able to look after themselves.

Similarly black mutations occur frequently among animals, both under domestication and in a state of nature. All are familiar with black dogs, cats, horses, fowls, ducks, pigeons. Black mutations, however, do not occur nearly so frequently as white ones. So far as we are aware no black mutation has been recorded among canaries, geese, guinea-fowl, ferrets, Java sparrows or doves, all of which produce white mutations.

On the other hand, in the wild state black species occur more frequently than normal-eyed white forms. This is probably because such

[1] Some egrets, such as the rock-egrets (*Demiegretta*) of eastern tropical coasts, are normally grey, but may be white, and this whiteness may be confined in individuals to the young or adult states.

creatures are less conspicuous than white ones. As examples of black mutations which occur in nature, we may cite black leopards, water rats, squirrels, foxes, barking deer (*Cervulus muntjac*), hawk-eagles, harriers, peppered moth (*Amphidasys betularia*), etc.

That many black species have arisen as sudden mutations from lighter-coloured animals seems tolerably certain from the facts that in Malacca the black leopard forms a local race; that some of the Gibbon apes are as often black as light coloured; that the American black bear is sometimes brown, while the other bears, when not brown, are almost invariably black.

Not uncommon, although rarer than black or melanistic forms, are reddish or chestnut varieties. These occur both among tame and wild animals. Among domesticated creatures, sandy cats, "red" pigeons, buff fowls, chestnut horses, red guinea pigs afford examples of this mutation. Among wild animals many of the species of squirrel, not naturally red, produce red mutations; and some of the grey owls—as, for example, the Indian race of the Scops (*Scops giu*)—throw off a red or chestnut form. As everyone knows, some species are normally red.

Green or olive species not unfrequently throw off yellow mutations. As examples of these we may cite yellow canaries, yellow budgerigars (*Melopsittacus undulatus*), goldfish, golden tench,

and the golden form of the common carp among captive animals; and among animals in a state of nature, yellow forms have been recorded of the rose-ringed Paroquet (*Palæornis torquatus*), the green woodpecker, the pike, and the eel. These lutinistic forms usually have normally coloured eyes. Sometimes, but only very rarely, these yellow forms throw off white sports—as, for example, the "silver" form of the goldfish. Finn has seen a white variety of the common carp. White canaries are excessively rare, while white budgerigars are unknown.

It is worthy of note that entirely yellow species of birds and fish are unknown. We would suggest that the explanation of this is that yellowness is correlated with some physical characteristic unfavourable to an organism exposed to the struggle for existence; hence individuals which are yellow are not permitted to survive. In some species of moths individuals occur in which the parts normally red are yellow. According to Bateson, a chalk pit at Madingly, near Cambridge, has long been known to collectors as a habitat of a yellow-marked form of the six-spot Burnet Moth (*Zygæna filipendulæ*). These lutinistic forms are not confined to one genus of Butterflies. Moreover, in the Pin-tailed Nonpareil Finch (*Eythrura prasina*) of the Eastern Archipelago the red tail and other red parts of the plumage are not infrequently replaced by

yellow in wild individuals of either sex and of any age. In the blue-fronted Amazon parrot (*Chrysotis æstiva*)—a most variable bird—the normally red edge of the pinion is sometimes yellow. Bateson, in his *Materials for the Study of Variation*, gives other examples of this kind of variation.

As further instances of mutations among animals which have been observed in nature, we may mention the *valezina* form of the female of the Silver-washed Fritillary Butterfly (*Argynnis paphia*) and the *helice* form of the female Clouded-yellow Butterfly (*Colias edusa*).

The common jelly-fish is an organism which frequently throws off sports, and some zoologists are of opinion that the medusoid *Pseudoclytia pentata* arose by a discontinuous variation from *Epenthesis folleata* or a closely allied form. Thomson discusses this particular case at some length on pages 87-89 of his *Heredity*, and gives it as his opinion that the evidence in favour of this latter having arisen as a mutation is "exceedingly strong."

It is our belief that many species of birds which occur in nature have been derived from other species which still exist, but as no one has ever seen the mutation take place, we cannot furnish any proof thereof. We merely rely on the fact that the species in question differ so slightly from one another that there seems every

likelihood that they have suddenly arisen and managed to establish themselves alongside of the parent species.

The Curassows, *Crax grayi*, *C. hecki*, each of which is only known by a very few specimens, appear to be mutations of the female of the globose Curassow, *Crax globicera*. The fact that when a female *hecki* bred in the London Zoological Gardens with a male *globicera*, the solitary young one which lived to grow up was a pure *globicera*, renders the assumption almost certain.

The Chamba Monaul (*Lophophorus chambanus*) seems to be a mutation of the male of the common Monaul or Impeyan Pheasant (*Lophophorus impeyanus*), the common species of the Himalayas.

The Three-coloured Mannikin (*Munia malacca*) of South India is probably simply a white-bellied form of the widely-ranging Black-headed Mannikin (*M. atricapilla*), which has the abdomen chestnut like the back. Intermediate wild-caught forms have been recorded.

The African Cordon-bleu (*Estrelda phœnicotis*) and Blue-bellied Waxbill (*E. cyanogastra*) would also seem to be mutations, as almost the only difference between them lies in the fact that the male of the former has a crimson cheek-patch, which is wanting in the latter.

The Ringed Finch (*Stictoptera annulosa*) of

Java, and Bicheno's Finch (*S. bichenovii*) of Australia, only differ in the former having the rump black, while in the latter it is white, and this difference appears to be of the nature of a mutation.

So, it might be urged, is the pure white breast of the male Upland Goose (*Chloëphaga magellanica*), which part, in the very similar *C. dispar*, is barred as in the females, the latter form being probably the ancestor.

The differences between the silver-grey-necked Crowned Crane of the Cape (*Balearica chrysopelargus*) and the dark-necked species of West Africa (*B. regulorum*) seem also to be not more than could be accounted for by mutation.

Peculiar forms, such as a rabbit with a convoluted brain or a mouse with a peculiar pattern of molar teeth, have been come upon by anatomists.

The above-cited mutations are all very considerable ones, and we do not profess to have mentioned a tenth part of those which have actually been recorded.

We trust that we have collected and set forth sufficient evidence to show that the phenomenon of discontinuous variation is a very general one, and this would seem to tell against the hypothesis of De Vries that species pass through alternate periods of comparative stability and periods when swarms of mutations appear. We

think it more probable that all species throw off at greater or less intervals discontinuous variations, and that it is upon these that natural selection acts.

We further hope that we have succeeded in making clear what we believe to be the very sharp distinction between continuous and discontinuous variations, even when the latter are inconsiderable, as frequently happens.

Before leaving the subject of variation it is necessary to notice the distinction, which Weismann was the first to emphasise, between somatic and germinal variations.

Every adult organism must be regarded as the result of two sets of forces ; inherited tendencies or internal forces, and the action of environment or external forces. The differences which the various members of a family show are due in part to the initial differences in the germinal material of which they are composed, and in part to the differences of their environment. The former differences are the result of what we may call germinal variations, and the latter the result of somatic variations. It is scarcely ever possible to say of any particular variation that it is a germinal or a somatic one, because even before birth a developing organism has been subjected to environmental influences. One of a litter may have received more nourishment than the others. Nevertheless, any marked variation which appears

at birth is probably largely germinal. According to Weismann and the majority of zoologists, there is a fundamental difference between these germinal and somatic variations, in that the former tend to be inherited, while the latter are never inherited. Weismann believes that very early in the formation of the embryo the cells which will form the generative organs of the developing organism are separated off from those cells which will go to build up the body, and become as much isolated from them as if they were contained in a hermetically-sealed flask, so that they remain totally unaffected by any changes which the environment effects in the somatic cells. Therefore, says Weismann, acquired characters cannot be inherited.

While the majority of zoologists believe that acquired characters are not inherited, probably not many will go so far as Weismann and declare that the environment cannot exercise *any* effect whatever on the germ cells.

Even though acquired characters or variations are not inherited, it does not follow that they do not play an important part in evolution. Acquired variations are the result of the way in which an organism reacts to its environment. If an organism is unable to react to its environment it must inevitably perish. If it is able to react, it matters not, so far as the chances of survival of the organism are concerned, whether the adaptation

is the result of a congenital variation or a somatic one. This will be rendered clear by a hypothetical example. Let us suppose that a certain mammal is forced, owing to the intensity of the struggle for existence, to migrate into the Arctic regions. Let us further suppose that this organism is preyed upon by some creature that hunts by sight rather than by scent. Let us yet further imagine that this predacious species is swifter than our animal, on which it preys. It is obvious that, other things being equal, the more closely the creature preyed upon assimilates to its surroundings the more likely is it to escape the observation of its foes, and so to survive and give birth to offspring. Now suppose that the glare from the snow-covered ground bleaches its coat. This whitening of the fur is a somatic variation, one which is induced by the environment. Such an animal will be as difficult to see, if the bleaching is such as to render it snow-white, as if its whiteness were due to a germinal variation. Thus, as regards its chances of survival, it matters not whether its whiteness be the result of germinal or somatic variation. But if the whiteness is due to a somatic variation, its offspring will show no tendency to inherit the variation; they will have in turn to undergo the bleaching process. If, on the other hand, the whiteness is due to a germinal variation, the offspring will tend to inherit this peculiarity and

to be born white. In such a case, it is unlikely that the fur of an organism which is naturally coloured will be completely bleached by the snow, and, even if it be, the bleaching process will take time, meanwhile the creature will be comparatively conspicuous. So that those which are naturally whiter than the average, that is to say, those in which the tendency to whiteness appears as a germinal variation, will be less conspicuous than those which tend to be the ordinary colour. Thus the former will enjoy a better chance of survival, and will be likely to transmit their whiteness to their offspring in so far as it is due to a germinal or congenital variation.

Thus, although none of the whiteness due to somatic variations is transmitted to the offspring, such variations are of considerable importance to the species, as they enable it to survive and allow time for the germinal variations in the required direction to appear.

That this case need not be purely hypothetical is shown by the fact that dun domestic pigeons, which are of an earthy-brown colour when fresh moulted, soon fade in the sun to a dull creamy hue. Thus a coloration adapted to an ordinary soil could soon be suited to a desert environment. The ruddy sheldrake also, normally a bright chestnut-coloured bird, and one that haunts exposed sunny places, in many cases fades very much, becoming almost straw-coloured.

Many variations which organisms display are of a mixed kind, being in part the result of inner forces and in part due to the action of the environment. In so far as they are due to this latter they do not appear to be inherited.

Thus, although we cannot say of many variations whether they are germinal, or somatic, or of a mixed kind, it is of great importance to keep continually in mind the fundamental differences between the two kinds.

Some somatic variations are due to the direct action of the environment; they are merely the expression of the manner in which an organism responds to external stimuli.

What is the cause of germinal variations? This is a question to which we are not yet in a position to give a satisfactory answer.

The attempt to explain their origin plunges us into the realm of theory. This doubtless is a realm full of fascination, but it is an unexplored region of extreme darkness, in which, we believe, it is scarcely possible to take the right road until more of the light of fact has been shed upon it.

In the chapter dealing with inheritance we shall indicate the lines along which it is likely that future progress will be made.

CHAPTER IV

HYBRIDISM

The alleged sterility of hybrids a stumbling-block to evolutionists—Huxley's views—Wallace on the sterility of hybrids—Darwin on the same—Wallace's theory that the infertility of hybrids has been caused by Natural Selection so as to prevent the evils of intercrossing—Crosses between distinct species not necessarily infertile—Fertile crosses between species of plants—Sterile plant hybrids—Fertile mammalian hybrids—Fertile bird hybrids—Fertile hybrids among amphibia—Limits of hybridisation—Multiple hybrids—Characters of hybrids—Hybridism does not appear to have exercised much effect on the origin of new species.

THE alleged sterility of the hybrids produced by crossing different species has long proved a great stumbling-block to evolutionists. Huxley, in particular, felt the force of this objection to the Darwinian theory. If the hybrids between natural species are sterile, while those of all the varieties which the breeder has produced are perfectly fertile, it is obviously quite useless for evolutionists to point with pride to the results obtained by the breeder, and to declare that his products differ from one another to a greater extent than do many well-recognised species.

"After much consideration, and with no bias against Mr Darwin's views," wrote Huxley to the *Westminster Review* in 1860, "it is our clear conviction that, as the evidence now stands, it is not absolutely proven that a group of animals having all the characters exhibited by species in nature, has ever been originated by selection, whether natural or artificial. Groups having the morphological nature of species, distinct and permanent races, in fact, have been so produced over and over again; but there is no positive evidence at present that any group of animals has, by variation and selective breeding, given rise to another group which was in the least degree infertile with the first. Mr Darwin is perfectly aware of this weak point, and brings forward a multitude of ingenious and important arguments to diminish the force of the objection. We admit the value of these arguments to the fullest extent; nay, we will go so far as to express our belief that experiments, conducted by a skilful physiologist, would very probably obtain the desired production of mutually more or less infertile breeds from a common stock in a comparatively few years; but still, as the case stands at present, this little 'rift within the lute' is not to be disguised or overlooked."

Similarly Wallace writes, at the beginning of chapter vii. of his *Darwinism*: "One of the greatest, or perhaps we may say the greatest, of

all the difficulties in the way of accepting the theory of natural selection as a complete explanation of the origin of species, has been the remarkable difference between varieties and species in respect of fertility when crossed. Generally speaking, it may be said that the varieties of any one species, however different they may be in external appearance, are perfectly fertile when crossed, and their mongrel offspring are equally fertile when bred among themselves; while distinct species, on the other hand, however closely they may resemble one another externally, are usually infertile when crossed, and their hybrid offspring absolutely sterile. This used to be considered a fixed law of nature, constituting the absolute test and criterion of a species as distinct from a variety; and so long as it was believed that species were separate creations, or at all events had an origin quite distinct from that of varieties, this law could have no exceptions, because if any two species had been found to be fertile when crossed and their hybrid offspring to be also fertile, this fact would have been held to prove them to be not species but varieties. On the other hand, if two varieties had been found to be infertile, or their mongrel offspring to be sterile, then it would have been said—These are not varieties, but true species. Thus the old theory led inevitably to reasoning in a circle, and what might be

only a rather common fact was elevated into a law which had no exceptions."

Thus the sterility of hybrids was a zoological bogey which had to be demolished. The plan of campaign adopted by Darwin and Wallace was, firstly, to try to disprove the assertion that the hybrids between different species are always sterile, and secondly, to find a reason for the alleged sterility of these hybrids.

Darwin succeeded in obtaining some examples of crosses between botanical species which were said to be fertile. These he quotes in chapter viii. of *The Origin of Species.* As regards animals, he met with less success. "Although," he writes, "I do not know of any thoroughly well-authenticated cases of perfectly fertile hybrid animals, I have some reason to believe that the hybrids from *Cervulus vaginalis* and *reevesii,* and from *Phasianus colchicus* and *P. torquatus* and with *P. versicolor* are perfectly fertile. There is no doubt that these three pheasants, namely, the common, the true ring-necked, and the Japan, intercross, and are becoming blended together in the woods of several parts of England. The hybrids from the common and Chinese geese (*A. cygnoides*), species which are so different that they are generally ranked in distinct genera, have often been bred in this country with either pure parent, and in one single instance they have

bred *inter se.* This was effected by Mr Eyton, who raised two hybrids from the same parents but from different hatches; and from these two birds he raised no less than eight hybrids (grandchildren of the pure geese) from one nest. In India, however, these cross-bred geese must be far more fertile; for I am assured by two eminently capable judges, namely, Mr Blyth and Captain Hutton, that whole flocks of these crossed geese are kept in various parts of the country; and as they are kept for profit, where neither pure parent species exists, they must certainly be highly fertile.[1] . . . So again there is reason to believe that our European and the humped Indian cattle are quite fertile together; and from facts communicated to me by Mr Blyth, I think they must be considered as distinct species."

Darwin does not seem to have been very satisfied with the evidence he had collected, for he said: "Finally, looking to all the ascertained facts on the intercrossing of plants and animals, it may be concluded that some degree of sterility,

[1] After years of observation of these Indian geese, Finn is convinced they are now, at all events, pure Chinese; it is possible that they really were hybrids in Blyth's time, but that fresh importations of geese from China, such as still occur, may have ultimately swamped the blood of the common goose. The fertility of the hybrid geese was, however, known to such early writers as Pallas and Linnæus. Darwin himself, at a later date, bred five young from a pair of such hybrids (*Nature*, Jan. 1, 1880, p. 207).

both in first crosses and in hybrids, is an extremely general result; but that it cannot, under our present state of knowledge, be considered as absolutely universal."

Similarly Wallace writes: "Nevertheless, the fact remains that most species which have hitherto been crossed produce sterile hybrids, as in the well-known case of the mule; while almost all domestic varieties, when crossed, produce offspring which are perfectly fertile among themselves."

Darwin resorted to much ingenious argument in his attempt to explain what he believed to be the almost universal sterility of hybrids, as opposed to mongrels or crosses between varieties. He pointed out that changed conditions tend to produce sterility, as is evidenced by the fact that many creatures refuse to breed in confinement, and believed that the crossing of distinct wild species produced a similar effect on the sexual organs. He expressed his belief that the early death of the embryos is a very frequent cause of sterility in first crosses.

Wallace thus summarises Darwin's conclusions as to the cause of the sterility of hybrids: "The sterility or infertility of species with each other, whether manifested in the difficulty of obtaining first crosses between them or in the sterility of the hybrids thus obtained, is not a constant or necessary result of species difference, but is in-

cidental on unknown peculiarities of the reproductive system. These peculiarities constantly tend to arise under changed conditions owing to the extreme susceptibility of that system, and they are usually correlated with variations of form or of colour. Hence, as fixed differences of form and colour, slowly gained by natural selection in adaptation to changed conditions, are what essentially characterise distinct species, some amount of infertility between species is the usual result."

But Wallace has not been content to let the matter remain where Darwin left it. He has boldly tried to make an ally of this bogey of the infertility of hybrids. On page 179 of *Darwinism* he argues, most ingeniously, that the sterility of hybrids has been actually produced by natural selection to prevent the evils of the intercrossing of allied species. We will not reproduce his argument for the simple reason that it is now well-known, or should be well-known, that hybrids between allied species are by no means always sterile. The doctrine of the infertility of hybrids seems to have been founded on the fact that the hybrids best known to breeders, namely the cross between the ass and the horse, and those between the canary and other finches, are sterile.

Fertile Crosses between Species of Plants

In the case of plants the number of fertile hybrids between species is so large that we cannot attempt to enumerate them. De Vries cites several instances in Lecture IX of his *Species and Varieties: Their Origin by Mutation.*

One of these—the hybrid between the purple and the yellow species of Lucerne which is known to botanists as *Medicago media* is, writes De Vries, "cultivated in some parts of Germany on a large scale, as it is more productive than the ordinary lucerne." Other examples of perfectly fertile plant hybrids cited by De Vries are the crosses between *Anemone magellanica* and *A. sylvestris*, between *Salix alba* and *Salix pentandra*, between *Rhododendron hirsutum* and *R. ferrugineum.*

He gives an instance of a hybrid—*Ægilops speltæformis*, which, though fertile, is not so fertile as a normal species would be. It is worthy of note that Burbank of California has obtained a hybrid between the blackberry and the raspberry, which is not only fertile, but quite popular as producing a novel fruit.

Sterile Plant Hybrids

De Vries does not cite nearly so many examples of sterile hybrids, presumably because they are not so easy to find. He mentions the sterile

"Gordon's currant," which is considered to be a hybrid between the Californian and the Missouri species. He also gives *Cytisus adami* as an absolutely sterile hybrid, this being a cross between two species of Labernum—the common and the purple.

In the case of animals the known hybrids are so much less numerous that we are able to furnish a list which may be taken as fairly exhaustive.

Fertile Mammalian Hybrids

Taking the mammals first, we find that, in addition to those cited by Darwin, there are several recorded cases of crosses between well-defined species which are fertile.

There is the hybrid between the brown bear and the polar bear, which is perfectly fertile. In the London Zoological Gardens there is a specimen of this hybrid, also one of this individual's offspring by a pure polar bear.

The stoat has been crossed with the domestic ferret, a descendant of the polecat, a very distinct species; the resulting hybrids have nevertheless proved fertile.

The bull American bison produces with the domestic cow hybrids known as "cataloes," which are fertile. The reverse cross of the domestic bull with the bison cow does not, however, succeed at all, which reminds us of what happens in the case of finch-hybrids.

Bird fanciers when crossing the canary with wild species of finch, almost invariably use a hen canary as the female parent, because domesticated female animals breed more readily than do captive wild ones.

The domestic yak breeds frequently in the Himalayas with the perfectly distinct zebu or humped cow of India, and the hybrids are fertile. Yet the zebu and the Indian buffalo, living constantly side by side in the plains of India, never interbreed at all.

Among wild ruminants of this hollow-horned family, the Himalayan Argali (*Ovis ammon*) ram, a giant sheep of the size of a donkey, has been known to appropriate a herd of ewes of the Urial (*O. vignei*), a very distinct species of the size of a domestic sheep. Many hybrids were born, and these, in turn, bred with the pure urials of the herd.

In our parks the little Sika deer of Japan (*Cervus sika*), a species about the size of the fallow-deer, with an even more marked seasonal change of colouration and antlers having only three tines, breeds with the red deer, and the hybrids are fertile.

In certain parts of Asia Minor the natives cross the female one-humped camel with the male of the bactrian or two-humped species. The hybrids (which are one-humped) will breed with the pure species; but, although the hybrids are

strong and useful, the three-quarter bred beasts are apparently of little value.

Fertile Bird Hybrids

Coming to birds, we are confronted by a longer list of fertile hybrids. This is the natural outcome of the fact that a greater number of bird species have been kept in captivity.

The oldest known fertile hybrid is that between the common and Chinese geese above cited, but many others have since been recorded. Even among birds so seldom bred, comparatively, as the parrot family, a fertile hybrid has been produced, that between the Australian Rosella Parrakeet (*Platycercus eximius*) and Pennant's Parrakeet (*P. elegans*). The hybrid was first described as a distinct species, the Red-mantled Parrakeet (*P. erythropeplus*). These two parrakeets, though nearly allied, are very distinct; Pennant's being coloured red, blue, and black, with a distinct young plumage of uniform dull green; the rosella in addition to the above colours displays much yellow and some white and green. It is, moreover, considerably smaller and has no distinct youthful dress.

The Amherst Pheasant (*Chrysolophus amherstiæ*) and the Gold Pheasant (*C. pictus*) have long been known as producing hybrids which are fertile either *inter se* or with the parents. Here the species are still more distinct; not only

are the leading colours of the Amherst white and green, instead of red and gold, but it is a bigger bird with a larger tail and smaller crest, and a bare patch round the eyes.

The Pintail Duck (*Dafila acuta*) and the Mallard or Wild Duck and its domestic descendants (*Anas boscas*), when bred together, produce hybrids which have been proved fertile between themselves and with the pure pintail. Any sportsman or frequenter of our parks can see for himself the distinctness of the species concerned.

The Pied Wagtail (*Motacilla lugubris*) and the Grey Wagtail (*M. melanope*) have produced hybrids in aviaries, which have proved fertile. The two species are distinct in every way, as all British ornithologists know.

The Cut-throat Finch (*Amadina fasciata*) and Red-headed Finch (*A. erythrocephala*) of Africa have hybridised in aviaries, and the produce has proved fertile. The red-headed finch, among other differences, is far larger than the cut-throat, and the males have the head all red, not merely a throat-band of that colour.

The Japanese Greenfinch (*Ligurinus sinicus*) which is not green, but brown and grey, with bolder yellow wing- and tail-markings than our larger European greenfinch, has produced fertile hybrids with this latter bird.

The Red Dove of India (*Oenopopilia tranquebarica*) has produced hybrids with the tame



MALE AMHERST PHEASANT
The chief colours of this species (*Chrysolophus amherstiæ*), are white and metallic green, so that it is very different in appearance from its near ally the gold pheasant.

Collared Dove (*T. risorius*) and these have bred again when paired with the red species. *O. tranquebarica*, although presenting a general similarity to the collared dove, is truly distinct, being much smaller, with a shorter tail, and displaying a marked sex-difference (the male only being red, and the female drab). Its voice is also utterly unlike the well-known penetrating and musical *coo* of the Collared Dove.

There is a large class of fertile wild hybrids produced between forms differing only in colour, such as those between the Hooded Crow (*Corvus cornix*) and Carrion Crow (*Corvus corone*), the various species of *Molpastes* bulbuls, and the Indian Roller (*Coracias indica*) and Burmese Roller (*C. affinis*). Indeed, it may be said that wherever two such colour-species meet they hybridize and become more or less fused.

In this connection sportsmen, as mentioned by Darwin, performed unconsciously a most interesting experiment when, more than a century ago, they introduced largely into their coverts the Chinese Ring-necked Pheasant (*Phasianus torquatus*) and the Japanese *P. versicolor*. So freely has the former bred with the common species already present there (*Phasianus colchicus*) that nowadays nearly all our English pheasants show traces of the cross in the shape of white feathers on the neck, or the green tinge of the plumage of the lower back. The influence of the Japanese

Green Pheasant (*P. versicolor*) has been very slight.

It is, of course, open to anyone to assert that such crosses are not true hybrids, as the species are not fully distinct, but mere colour-mutations.

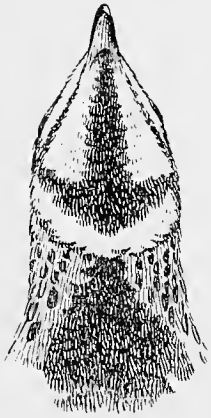
The fact of the intermingling, however, is a fatal blow to the theory of recognition marks, since it demonstrates that merely distinctive colouring is not a preventative of cross-breeding. To this matter we shall return later.

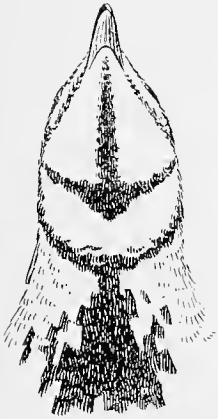
Fertile Hybrids among Amphibia

Our Crested Newt (*Molge cristata*) and the Continental Marbled Newt (*M. marmorata*) interbreed in France, in the wild state, and the resulting hybrid was at first described as a distinct species, under the name of *Molge blasii.* These two newts differ greatly in appearance. In the Marbled Newt the colouration is brilliant green and black above, and shows no orange below, thus differing much from that of the Crested Newt, which is black above and mottled with orange beneath, while the crest of the breeding-male of this species lacks the notches which are so conspicuous in that of the Crested Newt.

Insects

Among insects, M. de Quatrefages states that the hybrid progeny of the silk-moths *Bombyx*





By permission of the Avicultural Society

HARLEQUIN QUAIL
(Coturnix delegorguei)

RAIN QUAIL
(Coturnix coromandelica)

The markings on the throats of these quails are of the type usually put down as "recognition marks," but as the Harlequin Quail is African and the Rain Quail Indian, the two species cannot possibly interbreed. The pattern, then, can have no "recognition" significance.

cynthia and *B. arrindia* are fertile for eight generations when bred *inter se*.

Limits to the Possibilities of Hybridisation

Hybrids can apparently only be produced between species of the same natural family. The stories of cat-rabbits, deer-ponies, fowl-ducks, and similar distant crosses invariably break down on close examination. A belief in such remote crosses characterized the ancient "bestiaries," and still lingers, as witness the falsely-reputed crosses alluded to above.

This belief has no doubt arisen from the fact that the domestic breeds of dogs, fowls, etc., are popularly confounded with truly distinct species. Mongrels are well known to be readily produced, and hence the notion arises that hybrids between the most widely-separated species are possible.

In practice, the most remote cross of which authenticated specimens exist is that between the red grouse and the domestic fowl (bantam cock). It is true that the grouse are commonly ranked by ornithologists as a family distinct (*Tetraonidae*) from that of the pheasants and partridges (*Phasianidae*), to which the fowl belongs; but the relationship is admittedly very close, and we doubt if general zoologists would countenance the maintenance of the families as distinct. Ornithologists are notoriously apt to

over-rate small differences when drawing up a classification. It would be therefore safe to say, in the present state of our knowledge, that species belonging to different natural families cannot hybridize.

In some cases multiple hybrids have been produced. Thus, at the London Zoological Gardens, many years ago, a hybrid between the Gayal of India (*Bos frontalis*) and the Indian humped cow mentioned above was put to an American bison, and produced a double hybrid calf.

M. G. Rogeron of Angers bred many hybrids from a male pochard and a duck bred from a Mallard and a Gadwall.

More recently, Mr J. L. Bonhote has succeeded in combining the blood of five wild species of ducks in one individual.

Mr J. T. Newman has also bred turtle-doves containing the blood of three distinct species.

A cross, which usually results in sterile offspring, may in very rare cases produce a fertile individual; thus, Mr A. Suchetet once succeeded in obtaining a three-quarter-bred bird from the not uncommon hybrid of the tame pigeon and tame collared dove (*Turtur risorius*), which is usually barren, by pairing it with a dove; but the bird thus produced, when again paired with a dove, was itself sterile.

Some of the cases here given seem to encourage

Darwin's view that domestication tends to eliminate sterility; but it is doubtful if this can be upheld. The hybrid between the Muscovy duck (*Cairina moschata*) and common duck is usually, at all events, sterile, like that between the pigeon and dove; yet all these birds have been long domesticated. The hybrid between the fowl and the guinea-fowl is likewise barren, nor has the long domestication of the horse and ass lessened the sterility of the mule.

Some facts may be noted respecting the characters of hybrids. In the first place, it is important to notice that the characters of the hybrid vary according to the sexes of the species concerned; thus, the "hinny," which is bred from a horse and a she-ass, is a different animal from the true "mule," which is bred from the jackass and mare, and is inferior to it.

Similarly, Mr G. E. Weston, a great authority on British cage-birds and their hybrids, informs us that when hybrids are bred from a male canary and a hen goldfinch or siskin—contrary to the almost universal practice of using the hen canary for crossing—the progeny are inferior in size and colour to the hybrids obtained in the ordinary way.

Hybrids, in animals at all events, differ from crosses between mutations or colour-variations in not exhibiting the phenomenon of alternative inheritance; they do not follow one parent or

the other exclusively, but always exhibit some blending of the characters of both, which is, after all, what might have been expected, since well-defined species usually differ in more than one character.

Thus, the cross between the Amherst and gold pheasants chiefly resembles the latter, but has the ruff white as in the Amherst, while the crest, though in form it resembles that of the gold species, is not yellow as in that species, nor red as in the Amherst, but of an intermediate tint, brilliant orange.

The mule between the horse and ass, as all know, combines the shapes of the two parents, though in colour it follows the horse rather than the ass.

When two remote species, one or each of which possesses some distinctive structural peculiarity, are crossed, the hybrid does not inherit such points. The guinea-fowl has a helmet, and a pair of wattles on the upper jaw; the common fowl a comb, and a pair of wattles on the lower jaw; but in the hybrid no comb, helmet, or wattles are present.

The Muscovy drake has a bare red eye-patch, and the male of the common duck curled middle-tail feathers; in the hybrid neither of these peculiarities is reproduced.

In a cross between nearly-related forms, the peculiarity of one species may be reproduced in

a modified form in the hybrid; for instance, in that between the blackcock (*Tetrao tetrix*) and the capercailzie (*T. urogallus*), the forked tail of the former reappears to a small extent in the hybrid.

Very interesting are those cases in which the hybrid resembles neither parent, but tends to be like an altogether distinct species, or to have a character of its own. Thus the hybrids between the pied European and chestnut African sheldrakes (*Tadorna cornuta* and *Casarca cana*), now in the British Museum, bear a distinct resemblance to the grey Australian sheldrake (*C. tadornoides*). In pheasants, also, the crosses between the common and gold, common and Amherst, gold and Japanese, and gold and Reeves' pheasants, widely different as all these birds are in colouration, are remarkably alike, being all chestnut-coloured birds with buff median tail-feathers. These may be seen in the British Museum. This phenomenon, together with the above-noted disappearance of specialised features in hybrids, is possibly comparable to the "reversion" observed when widely-distinct domestic breeds are crossed, and so may give us an idea of the appearance of the ancestors of the groups of species concerned.

In the few cases wherein several generations of hybrids have been bred *inter se*, there seems to have been no reversion to the original pure

types, such as happens when colour-forms are crossed.

M. Suchetet bred hybrid gold = Amherst pheasants for four generations, and they retained the hybrid character. The young bred by Darwin from a pair of common = Chinese geese hybrids "resembled," he says, "in every detail their hybrid parents."

When hybrids have been—as has far more usually been the case — bred back to one of the pure stocks, the hybrid characters have shown, as might be expected, a tendency quickly to disappear. The three-quarter-bred polar bear now in the London Zoological Gardens is a pure polar save for a brown tinge on the back. A three-quarter Amherst = gold pheasant in the British Museum is a pure Amherst save for the larger crest, and a patch of red on the abdomen. When three-quarter-bred pintail = common duck hybrids were bred back to the pintail, the offspring "lost all resemblance to the common duck." In the case of the Argali-urial herd of wild sheep above-mentioned, after the usurping Argali ram had been killed by wolves, the hybrids bred with the urials, with the result that the herd renewed the appearance of pure urial.

Thus, except in the very improbable case of a family of hybrids going off and starting a colony by themselves, the effect of hybridism on the evolution of species seems likely to have been

nil. It is, however, curious that three-quarter-bred animals have rarely, if ever, been recorded in a state of nature, though a good many wild-bred hybrids are on record.

This points to some unfitness for the struggle for existence even in a fertile hybrid. It is necessary to emphasise the fact that wild hybrids are always exceedingly rare as individuals, in spite of what has been said as to the number of recorded crosses.

More hybrid unions have been noted among the duck family than anywhere else in the animal kingdom. Nevertheless Finn never once saw a hybrid duck for sale in the Calcutta market, although for seven years he was constantly on the look-out for such forms; nor does Hume record any such specimen in his *Game Birds and Wild Fowl of India.*

The hybrid which occurs most commonly as an individual is that between the blackcock and capercailzie, which is recorded yearly on the Continent; but it appears to be sterile, and so has no influence on the species.

Wild hybrids between mammals are far rarer even than bird hybrids, the only ones which seem to be on record being those between the Argali and Urial above alluded to; those between the brown and blue hares and the common and Arctic foxes.

A consideration of the phenomena of hybridism

thus leads us to the conclusion that, although many hybrids are fertile, the crossing of distinct species has exercised little or no effect on the origin of species. Even where allied species, like the pintail and the mallard ducks, whose hybrid offspring is known to be fertile, inhabit the same breeding area and occasionally interbreed in nature, such crossing does not, for some reason or other, appear to affect the purity of the species.

Very different, of course, is the effect of crossing a mutation within a species with the parent form; the offspring are, as we shall see, likely to resemble one or other of the parents; so that, if the mutation occur frequently enough and be favourable to the species, the new form may in course of time replace the old one.

CHAPTER V

INHERITANCE

Phenomena which a complete theory of inheritance must explain —In the present state of our knowledge it is not possible to formulate a complete theory of inheritance—Different kinds of inheritance—Mendel's experiments and theory—The value and importance of Mendelism has been exaggerated—Dominance sometimes imperfect—Behaviour of the nucleus of the sexual cell—Chromosomes—Experiments of Delage and Loeb —Those of Cuénot on mice and Castle on guinea pigs—Suggested modification of the generally-accepted Mendelian formulae—Unit characters—Biological isomerism—Biological molecules—Interpretation of the phenomena of variation and heredity on the conception of biological molecules—Correlation — Summary of the conception of biological molecules.

WE have seen that variations may be, firstly, either acquired or congenital, and, secondly, fluctuating or discontinuous. We have further seen that acquired variations—at all events in the higher animals—do not appear to be inherited, and therefore have not played a very important part in the evolution of the animal world. Discontinuous congenital variations or mutations are the usual starting points of new species. It is not unlikely that fluctuating congenital variations, although they do not appear to give rise directly to new species, may play a

considerable part in the making of new species, inasmuch as they may, so to speak, pave the way for mutations.

We are now in a position to consider the exceedingly difficult question of inheritance. We know that offspring tend to resemble their parents, but that they are always a little different both from either parent and from one another. How are we to account for these phenomena? What are the laws of inheritance, whereby a child tends to inherit the peculiarities of its parents, and what are the causes of variation which make children differ *inter se* and from their parents?

Scores of theories of inheritance have been advanced. It is scarcely exaggerating to assert that almost every biologist who has paid much attention to the subject has a theory of inheritance which differs more or less greatly from the theory held by any other biologist.

As regards the phenomena of heredity we may say *Tot homines tot sententiæ.*

For this state of affairs there is a good and sufficient reason. We are not yet in possession of a sufficient number of facts to be in a position to formulate a satisfactory theory of inheritance. A complete theory of heredity must explain, among other things, the following phenomena :—

1. Why creatures show a general resemblance to their parents.

2. Why they differ from their parents.

3. Why the members of a family display individual differences.

4. Why the members of a family tend to resemble one another more closely than they resemble individuals belonging to other families.

5. Why "sports" sometimes occur.

6. Why some species are more variable than others.

7. Why certain variations tend to occur very frequently.

8. Why variations in some directions seem never to occur.

9. Why a female may produce offspring when paired with one male of her species and not when paired with another male of the species.

10. Why organisms that arise by parthenogenesis appear to be as variable as those which are sexually produced.

11. Why certain animals possess the power of regenerating lost parts, while others have not this power.

12. Why most plants and some of the lower animals can be produced asexually from cuttings.

13. Why mutilations are not inherited.

14. Why acquired characters are rarely, if ever, inherited.

15. Why the ovum puts forth the polar bodies.

16. Why the mother-cell of the spermatozoa produces four spermatozoa.

17. Why differences in the nature of the food administered to the larvæ of ants determines whether these shall develop into sexual or neuter forms.

18. Why the application of heat, cold, etc., to certain larvæ affects the nature of the imago, or perfect insect, to which they will give rise.

19. Why the females in some species lay eggs which can produce young without being fertilised.

20. Why some species exhibit the phenomena of sexual dimorphism, while others do not.

21. In addition to all the above, a satisfactory theory of inheritance must account for all the varied phenomena which are associated with the name of Mendel. It must explain the various facts with which we have dealt in the chapter on hybridism, why some species produce sterile hybrids when intercrossed, while others give rise to fertile hybrids, and yet others form no offspring when crossed; why the hinny differs in appearance from the mule, etc.

22. It must explain all the facts which constitute what is known as atavism.

23. It must account for the phenomenon of prepotency.

24. It must explain the why and the wherefore of correlation.

25. It must tell us the meaning of the results of the experiments of Driesch, Roux, and others.

26. It must render intelligible the effects of castration on animals.

Now, no existing theory of heredity can give anything approaching a satisfactory explanation of all these phenomena.

It is for this reason that we refrain from critically examining, or even naming, any of them.

We are convinced that in the present state of our knowledge it is not possible to formulate anything more than a provisional hypothesis.

It must not be thought that we consider the various theories that have been enunciated to be of no value. Erroneous hypotheses are often of the greatest utility to science, for they set men thinking and suggest experiments by means of which important additions to knowledge are made.

We now propose to set forth certain facts of inheritance, and from these to make a few deductions—deductions which seem to be forced upon us.

We would ask our readers to distinguish carefully between the facts we set forth, and the conclusions we draw therefrom. The former, being facts, must be accepted.

The interpretations we suggest should be rigidly examined, we would say regarded with suspicion, and all possible objections raised. It is only by so doing that any advance in knowledge can be made.

By inheritance we mean that which an organism receives from its parents and other ancestors —all the characteristics, whether apparent or dormant, it inherits or receives from its parents. Professor Thomson's definition—"all the qualities or characters which have their initial seat, their physical basis, in the fertilised egg cell"—seems to cover all cases except those where eggs are parthenogenetically developed.

The first fact of heredity which we must notice is that inheritance may take several forms. This is apparent from what was set forth in the chapter dealing with hybrids.

In considering the phenomena of inheritance it is convenient to deal with crosses in which the parents do not closely resemble one another, because by so doing we are able readily to follow the various characters displayed by each parent. It may, perhaps, be urged that such crosses occur but rarely in nature. This is true. But we should bear in mind that any theory of inheritance must explain the various facts of cross-breeding, so that, from the point of view of a theory of inheritance, crosses are as important as what we may term normal offspring. As inheritance is so much easier to observe in the former, it is but natural that we should begin with them. Our deductions must, if they be valid ones, fit all cases of ordinary inheritance, *i.e.* all cases where the offspring results from the

union of parents which closely resemble one another. Now, when two unlike forms interbreed, their offspring will fall into one of six classes.

I. They may exactly resemble one parent, or rather the type of one parent, for, of course, they will never be exactly like either parent; they must of necessity display fluctuating variations. The cases in which the offspring exactly resemble one parent type in all respects are comparatively few. They occur only when the parents differ from one another in one, two, or at the most three characters. Thus when an ordinary grey mouse is crossed with a white mouse the offspring are all grey, that is to say, they resemble the grey parent type. Although they are mongrels or hybrids, they have all the appearance of pure grey mice. This is what is known as unilateral inheritance.

II. The offspring may resemble one parent in some characters and the other in other characters. They may have, for example, the colour of one parent, the shape of the other, and so on. Thus if a pure, albino, long-haired, and rough-coated male guinea-pig be crossed with a coloured, short-haired and smooth-coated female, all the offspring are coloured, short-haired, and rough-coated. That is to say, they take after

the father in being rough-coated, but after the mother in being pigmented and short-haired. This form of inheritance is usually seen only in crosses between two types which differ in but few of their characters.

III. The offspring may display a blend of the characters of the two parents. They may be intermediate in type. They are not of necessity midway between the two parents; one of the parents may be prepotent. The crosses between the horse and the ass show this well. Both the mule, where the ass is the sire, and the hinny, where the horse is the sire, are more like the ass than like the horse; but the hinny is less ass-like than the mule. The offspring between a European and a native of India furnishes a good case of blended inheritance; Eurasians are neither so dark as the Asiatic nor so fair as the European.

IV. The offspring may show a peculiarity of one parent in some parts of the body and the peculiarity of the other parent in other parts of the body. This is known as particulate inheritance. The piebald foal, which is the result of a cross between a black sire and a white mare, is a good example of such inheritance. This does not appear to be a common form of inheritance.

V. The usual kind of inheritance is perhaps a combination between the forms II. and III.

In such cases the offspring display some paternal characters and some maternal ones, and some characters in which the maternal and paternal peculiarities are blended. An example of inheritance of this description is furnished by a cross between the golden and the amherst pheasants.

VI. The offspring may be quite unlike either parent. For example, Cuénot found that sometimes a grey mouse when crossed with an albino produces black offspring.

The first two kinds of inheritance were carefully investigated by Gregor Johann Mendel, Abbot of Brunn. The results of his experiments were published in the Proceedings of the Natural History Society of Brunn, in 1854, but attracted very little notice at the time.

Mendel experimented with peas, of which many varieties exist. He took a number of varieties, or sub-species, which differed from one another in well-defined characters, such as the colour of the seed coat, the length of the stem, etc. He made crosses between the various varieties, being careful to investigate one character only at a time. He found that the offspring of such crosses resembled, in that particular character, one only of the parents, the other parent apparently exerting no influence on it. Mendel

called the character that appeared in the offspring dominant, and the character which was suppressed, recessive. Thus when tall and short varieties were crossed the offspring were all tall. Hence Mendel said that tallness is a dominant character, and shortness a recessive character. Mendel then bred these crosses among themselves, and found that some of the offspring resembled one grandparent as regards the character in question while some resembled the other, and he found that those that showed the dominant character were three times as numerous as those that displayed the recessive character. He further found that all those of the second generation of crosses which displayed the recessive character bred true; that is to say, when they were bred together all their descendants exhibited this characteristic. The dominant forms, however, did not all breed true; some of them produced descendants that showed only this dominant character, others, when crossed, gave rise to some forms having the dominant character and some having the recessive character.

It is thus evident that organisms of totally different ancestry may resemble one another in external appearance. In other words, part of the material from which an organism is developed may lie dormant.

From the above results Mendel inferred, in

the case of what he called alternating characters, that only one or other of the pair can appear in the offspring, that they will not blend. If both parents display one of the opposing characters, the offspring will of course show it. But if one parent display one character and the other the opposing character, the hybrid offspring will display one only, and that which is dominant. The other character is suppressed for the time being. When, however, these hybrids are bred *inter se*, their gametes or sexual cells split up into their component parts, and then the recessives are free to unite with other recessives and thus produce offspring which show the recessive character.

His results can be set forth in symbols.

Let T stand for the tall form and D for the dwarf form. Since the offspring are composed of both the paternal and maternal gamete, we may represent them as TD. But dwarfness is, as we have seen, recessive, so that the offspring all look as though they were pure T's. When, however, we come to breed these TD's *inter se*, the gamete or sex-cell of each individual crossed breaks up into its component parts T and D, which unite with other free T or D units to form TD's or TT's or DD's. What are the possible combinations? A D of one parent may meet and unite with a D of the other parent, so that the resulting cells will be pure D, *i.e.* DD, and will give rise to pure dwarf

offspring. Or the D gamete from one parent may unite with a T gamete from the other parent, and the result will be a TD cross, but this, as we have seen, will grow up to look like a pure T, *i.e.* will become a tall organism. Similarly, a T gamete from one parent may unite with a T gamete of the other, and produce a pure tall form, or it may unite with a D and produce a hybrid TD, which gives rise to a tall form. Thus the possible combinations of offspring are DD, DT, TD, TT, but all these three last contain the dominant T gamete, and so develop into tall offspring; therefore, *ex hypothesi*, we shall have three tall forms produced to one dwarf form, but of these three tall forms two are not pure, and do not breed true. Mendel's experimental results accorded with what we should expect to obtain if the above explanation were correct. Hence the inference that there is such a splitting of the gametes in the sexual act seems a legitimate one.

Mendel's experiments are of great importance, for they give us some insight into the nature of the sexual act. But, as is usual in such cases, Mendel's disciples have greatly exaggerated the value and importance of his work. It is necessary to bear in mind that Mendel's results apply only to a limited number of cases—to what we may call balanced characters. In the case of characters which

do not balance one another, which are, so to speak, not diametrically opposed to one another, Mendel's law does not hold. A second important point is, that the dominance is in many cases not nearly so complete as it should be if the Mendelian formula correctly represented what actually occurs in nature. Further, the segregation of the gametes does not appear to be so complete as the above hypothesis requires it to be. The phenomena of inheritance seem to be far more complex than the thorough-going Mendelian would have us believe.

Let it be noted that it is not to the facts of Mendelism, but to some portions of what we may call the Mendelian theory, that we take exception.

Before passing on to consider some of the later developments of Mendelism, it is necessary for us to set forth briefly certain of the more important facts regarding the sexual act which the microscope has brought to light. We propose to state these only in the merest outline. Those who are desirous of pursuing the subject farther are referred to Professor Thomson's *Heredity*.

The germ cells, like all other cells, consist of a nucleus lying in a mass of cytoplasm. The nucleus is composed of a number of rod-like bodies, which are called chromosomes, because they are readily stainable.

These chromosomes appear, under ordinary circumstances, to be joined together end to end, and then look like a rope in a tangle.

When a cell is about to divide into two, these chromosomes become disjoined and can then be counted, and it is found that each cell of each species of animal or plant has a fixed number of these chromosomes. Thus the mouse and the lily have twenty-four chromosomes in each cell, while the ox is said to have sixteen of them per cell.

When a cell divides into two, each of these chromosomes splits by a *longitudinal* fissure into two halves, which appear to be exactly alike. One-half of every chromosome passes into each of the daughter cells, so that each of these is furnished with exactly half of each one of the rod-like chromosomes. In the cell division, which takes place immediately before the male gamete or generative cell meets the female gamete, the chromosomes do not divide into equal halves, as is usually the case. In this division half of them pass into one daughter cell and half into the other daughter cell, so that, prior to fertilisation both the male and the female gametes contain only half the normal number of chromosomes. In the sexual act the male and the female chromosomes join forces and then the normal number is again made up, each parent contributing exactly one half.

Biologists, with a few exceptions, seem to be agreed that these chromosomes are the carriers of all that which one generation inherits from another. Thus the cardinal facts of the sexual act are, firstly, prior to fertilisation the male and the female gamete each part with half their chromosomes; and, secondly, the fertilised cell is composed of the normal number of chromosomes, of which one-half have been furnished by each parent. Thus the microscope shows that the nucleus of the fertilised egg is made up of equal contributions from each parent. This is quite in accordance with the observed phenomena of inheritance.

But Delage has shown that a non-nucleated fragment of the ovum in some of the lower animals, as, for example, the sea-urchin, can give rise to a daughter organism with the normal number of chromosomes when fertilised by a spermatozoon. Conversely, Loeb showed that the nucleus of the spermatozoon can be dispensed with. Thus it seems that either the egg or the spermatozoon of the sea-urchin contains all the essential elements for the production of the perfect larva of a daughter organism. We are, therefore, driven to the conclusion that the fertilised ovum contains two sets of fully-equipped units. Only one of these seems to contribute to the developing organism. If this set happens to be composed of material derived from one only of the parents,

we can see how it is that we get unilateral inheritance in the case of a cross. Where, however, the units from the two parents intermingle, although only one set is active in development, the result will be blended inheritance. Thus, we may regard the fertilised egg as made up of two sets of characters—a dominant set, which is active in the production of the resulting organism, and a recessive set, which appears to take little or no part in the production of the organism.

This is quite in accordance with Mendelian conceptions.

Let X be an organism having the unit characters A *B* C D *E* F *G*, and let Y be another organism having the unit characters *a* b *c d* e *f* g. Now suppose that these behave as opposed Mendelian units, and that the unit characters in italics are dominant ones. Then the resulting individual will resemble each parent in certain unit characters. It may be represented by the formula a B c d E f G, but it will contain the characters A b C D e F g in a recessive form, so that its complete formula may be written

$$\left.\begin{matrix} \text{a B c d E f G} \\ \text{A b C D e F g} \end{matrix}\right\}$$

When these hybrids are paired together it will be *possible* to get such forms as $\begin{matrix} \text{A B C D E F G} \\ \text{A B C D E F G} \end{matrix}$ and $\begin{matrix} \text{a b c d e f g} \\ \text{a b c d e f g} \end{matrix}$ which exactly resemble the

respective grandparents, and these should breed absolutely true, if the segregation of the gametes is as pure as the Mendel's law seems to require.

There are, however, certain facts, which recent experimenters have brought to light, that seem to show that the segregation is not so complete as the law requires. For example, the so-called pure extracted forms may be found, when bred with other varieties, to have some latent characters. Thus Cuénot observed that extracted pure albino mice, that is to say, those derived from hybrid forms, did not all behave alike when paired with other mice. Those which had been bred from grey × white hybrids behaved, on being crossed, differently to those that had been bred from black × white hybrids; and further, those derived from yellow × white hybrids yielded yet other results on being intercrossed. Castle records similar phenomena in the case of guinea-pigs, and accordingly draws a distinction between recessive and latent characters. Recessive characters are those which disappear when they come into contact with a dominant character, but reappear whenever they are separated from the opposing dominant character. Latency is defined by Castle as "a condition of activity in which a normally dominant character may exist in a recessive individual or gamete."

The ordinary Mendelian pictures a unit character in a cross that obeys Mendel's law, as follows:— $\frac{D}{R,}$ the dominant character only showing. It seems to us that each unit character should be represented as a double entity, thus D(D), the portion within the bracket being latent. The cross would appear to be represented by the formula $\frac{D(R)}{R(D),}$ since the union appears to take the form of the transfer of the dormant latent characters. Now an extracted pure recessive will, on this hypothesis, bear the formula $\frac{R(D)}{R(D).}$ When such recessives are crossed the two dormant portions will ordinarily change places, and never appear, so that these extracted recessives will, under ordinary circumstances, appear to be as pure as the true pure recessives, which are represented by the formula $\frac{R(R)}{R(R).}$

Now, suppose that, from some cause or other, it is possible for the latent D to change places with the visible R, it is obvious that the impure nature of the extracted and hitherto apparently pure recessives will become manifest. This seems to be what happens under certain circumstances to the extracted albino mice. They

possess latent the character of their dominant ancestor.

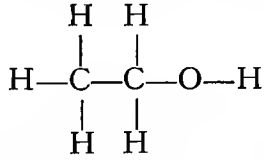
Mendelian phenomena force upon us the conclusion that organisms display a number of unit characters, each of which behaves in much the same way as a radicle does in chemistry, inasmuch as for one or more of these characters others can be substituted without interfering with the remaining unit characters. For example, it is possible to replace the chemical radicle NH_3 by the radicle Na_2; *e.g.* $(NH_3)_2SO_4$ (ammonium sulphate) may be transformed into Na_2SO_4 (sodium sulphate).

The conclusion that each organism is composed of a number of unit characters, which sometimes behave more or less independently of one another, is one which most biologists who have studied the phenomena of inheritance appear to have arrived at. Zoologists are mostly of opinion that these characters, or rather their precursors, exist as units in the fertilised egg. Very varied have been the conceptions of the nature of these biological units. Almost every biologist has given a name to his particular conception of them. Thus we have the gemmules of Darwin, the unit characters of Spencer, the biophors of Weismann, the micellæ of Naegeli, the plastidules of Haeckel, the plasomes of Wiesner, the idioblasts of Hertwig, the pangens of De Vries, and so on. It is unnecessary to

extend this list. It must suffice that almost every investigator of the phenomena of inheritance believes in these units, and calls them by a different name. Moreover, each clothes them with characteristics according to his taste or the fertility of his imagination.

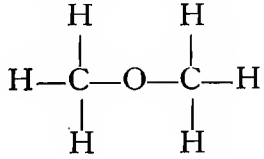
These units behave in such a way as to suggest to us an analogy between them and the chemical molecules. The sexual act would appear to resemble a chemical synthesis in some respects. One of the most remarkable phenomena of chemistry is that of isomerism. It not infrequently happens that two very dissimilar substances are found, upon analysis, to have the same chemical composition, that is to say, their molecules are found to be composed of the same kind of atoms and the same number of these. Thus chemists are compelled to believe that the properties of a molecule are dependent, not only on the nature of the atoms which compose it, but also on the arrangement of these within the molecule. To take a concrete example: Analysis shows that both alcohol and ether are represented by the chemical formula C_2H_6O. In other words, the molecule of each of these compounds is made up of two atoms of the element Carbon, six of the element Hydrogen, and one of the element Oxygen. Now, every chemical atom possesses the property which chemists term valency, in other words, the number of other atoms with which

it can directly unite is strictly limited. All atoms of the same element have the same valency. Monovalent atoms are those which can, under no circumstances, unite with more than one other atom. The Hydrogen atom is an example of such an atom. Divalent atoms, as, for example, that of Oxygen, can unite with one other atom of similar valency or with two monovalent atoms. Similarly, a trivalent atom, such as that of Nitrogen, can unite with three monovalent atoms. A tetravalent atom, such as that of Carbon, can combine with four monovalent atoms. There are also pentavalent and hexavalent atoms. Now, by indicating the valency of any given atom by a stroke for each monovalent atom with which it is able to combine, chemists have been able to represent the molecule of every compound, or, at any rate, of every inorganic compound, by what is known as a graphic or structural formula. Thus, ethylic alcohol is represented by the formula :—



$= C_2H_6O,$

and methylic ether by the structural formula :—



$= C_2H_6O.$

The formulæ indicate a very different arrangement of the nine atoms which compose the molecule in each case. And to this different arrangement the differing properties of the two compounds are supposed to be due. A rough illustration of the phenomenon of isomerism is furnished by written language. Thus, three different words can be made from the letters t, a, and r, *e.g.* tar, art, and rat. They also form tra, which does not happen to be an English word, although it might have been one.

Among organisms we sometimes observe a phenomenon which looks very like isomerism. The classical example of this is furnished by the butterflies *Vanessa prorsa* and *Vanessa levana.*

At one time these were supposed to belong to different species, since they differ so greatly in appearance. *Vanessa levana* is red, with black and blue spots. *Vanessa prorsa* is deep black, with a broad yellowish-white band across both wings. It is now known that the *levana* is the spring form and the *prorsa* the summer and autumn form of the same species. The pupæ of *levana* produce the *prorsa* form, but Weismann found that after being placed in a refrigerator they emerged, not as *prorsa*, but partly as *levana* and partly as another form intermediate in many respects between *levana* and *prorsa.* Weismann also succeeded, by exposing the winter pupa to a

high temperature, in making it give rise to the *prorsa* form, and not to the *levana* form, as it would ordinarily do.

Similar results have been obtained with the seasonally dimorphic *Pieris napi.* Standfuss, the Gräfin von Linden, and others have obtained like results in the case of other seasonally dimorphic butterflies. In some instances it has been proved that the change in the pigment is a purely chemical one; a similar transformation can be effected in the extracted pigment. But, we must bear in mind that the changes which are induced in this way are not confined to colour; they occur in the marking and shape of the wing.

Even more remarkable is the fact that in some sexually dimorphic species a change of temperature alters the female, so as to cause her to have the outward appearance of the male. For example, it has been found that warmth changes the colours of the female *Rhodocera rhamni* and *Parnassius apollo* into the colours of the male.

By applying rays of strong light, electric shock, or centrifuge, the Gräfin von Linden was able to change the colours of the butterflies to which the caterpillars gave rise. Pictet experimented on twenty-one species of butterflies, or rather on their caterpillars, and found that in nearly all cases when the caterpillars ate unusual food, they developed into butterflies with ab-

normal colouring. Schmankewitsch made the discovery that, in the case of the crustacean *Artemia*, he could produce either of two species according to the amount of salt in the water in which these creatures were placed. He declared that the anatomical differences between the species *Artemia salina* and *Artemia milhausenii* depended solely on the percentage of the salt in the surrounding water. He further stated that by adding still more salt he could change the *Artemia* into a new genus—*Branchipus*. More recent observers have cast doubt upon these results of Schmankewitsch. They, however, admit that the degree of salinity of the water has some effect on the form of the *Artemia*, although they suggest that factors other than concentration affect the result. In any case, it is now well-known that changes in the environment effect changes in the colouring of many crustacea. Pictet has shown that the alternating wet and dry seasons in some tropical countries are the cause of, or stimulus that induces, seasonal dimorphism in some butterflies. He was able to effect changes in the colouring of certain species by means of humidity.

The most important cases, from our point of view, are those in which the application of heat or cold to a pupa has affected the colour, shape, etc., of the emerging butterfly. Here we have but one factor, that of temperature. All

the material for the formation of the butterfly is already stored up in the pupa. The unit characters, or their precursors, are all there, and they take one form or another according to the stimulus applied.

Phenomena of this kind can, we think, be accounted for only on the assumption that the unit characters affected are each developed from a definite portion of the fertilised egg, that each of these portions, these precursors of the unit characters, is, like a chemical molecule, made up of a number of particles, and that upon the arrangement of these particles in its precursor in the egg depends the form that the unit character derived from it will take. One arrangement of these particles gives rise to one form of unit character, while another arrangement will give rise to a totally different form of unit character.

Thus, some organisms seem to display a biological isomerism akin to chemical isomerism, save that the particles which in organisms take the place of chemical atoms are infinitely more complex.

In other words, the precursors in the fertilised egg of each of these unit characters behave in some respects like chemical molecules.

In order to avoid the manufacture of fresh terms we may speak figuratively of the germ cells as being composed of biological molecules,

which in their turn are built up of biological radicles and atoms. These behave in some ways like chemical molecules, radicles, and atoms, as the case may be.

It seems legitimate to regard each unit character in the adult as the result of the development of one or more of the biological molecules which compose the nucleus of the fertilised egg. These biological molecules are, of course, a million-fold more complex than chemical molecules. Each biological atom must contain within itself a number of the very complex protoplasmic molecules. This view of the structure of the germ cell seems to force itself upon the observer. Notwithstanding this, the conception will have no value unless it seems to throw light on the various phenomena of heredity, variation, etc.

Let us then try to interpret some of these.

Each chemical element is made up of atoms which are all of the same kind, but no two elements are made up of the same kind of atoms, although chemists are now inclined to conceive of all the various kinds of atoms as made up of varying amounts of some primordial substance. In any case, the molecules of chemical compounds are made up of various kinds of atoms. With biological atoms the case would seem to be different. All would appear to be made up of the same kind of substance, and the differences shown by the various unit characters that go to

make up an organism would seem to be due to the different numbers and the varying arrangement of the biological atoms which compose the molecules from which unit characters are derived. This would be quite in accordance with the chemical notion of allotropy. Thus, the graphite and the diamond molecules are both made up of the same kind of atoms.

But the biological atoms are living, that is to say, they are continually undergoing anabolism and katabolism, growth and decay. They exhibit all the phenomena of life, they must grow and divide, and they must absorb nourishment; hence it is not surprising that they should differ slightly among themselves, that they should exhibit the phenomenon of variation. Although probably all are composed of the same living material, no two are exactly alike, hence the molecules formed by them will also differ from one another. Thus we can see why it is that all organisms exhibit fluctuating variations.

Very different are the discontinuous variations or mutations. These would seem to be due to either a rearrangement of the biological atoms in the biological molecule or the splitting up of the latter into two or more molecules. This, of course, is pure hypothesis. Let us take an imaginary example. Suppose that a biological molecule contains eighteen biological atoms, and that these are arranged in the form of an equi-

lateral triangle, six of them going to each side. Suppose now, that from some cause or other they rearrange themselves to form an isosceles triangle, so that only four form the base and seven go to each of the remaining sides. Such an arrangement would give rise to a mutation. Suppose now that, from some cause or other, this triangular biological molecule were to split up into two triangles, each having three atoms to each side, we should obtain a still more marked mutation. We are far from saying that the atoms in the organic molecule ever take such forms. We have merely attempted to give rough but simple illustrations of the kind of processes which on this hypothesis might be expected to take place in the germ cells or the fertilised eggs.

Let us now consider the sexual act from this aspect. The various molecules (we speak, of course, of biological molecules) of the male parent meet those of the female parent, and a synthesis occurs, which results in the formation of a new organism. When these two sets of gametes meet one another, one of several events may happen. The gametes may refuse to combine. This will occur whenever they are of very different constitution; thus it is that widely differing species will not interbreed. But it may even happen that gametes of individuals of the same species may refuse to coalesce on account of some peculiarity in the composition of one or

other of them. Secondly, they may be able to form some sort of a union, but, owing to their diverse nature, the resulting molecules may be so complex that they cannot be broken up into equal halves, and as this seems to be necessary for the sexual act, the resulting organism will be sterile. Thirdly, the two sets of gametes may enter into a proper union, that is to say, form new molecules, but these may be of such different structure to the molecules of the gametes, that the resulting offspring will be quite unlike their parents in appearance. Fourthly, some or all the groups of radicles in each gamete may be united so closely that in the sexual act they do not break up, but enter bodily into the new resulting organism. In these circumstances the inheritance of the offspring will follow Mendel's law. Fifthly, there may be some slight disturbance of the molecule, perhaps one or only a few atoms will be replaced by those of the other gamete. This would give us impure dominance.

Thus this hypothesis appears to be compatible with the various modes of inheritance.

The curious phenomenon known as prepotency would seem also to be quite in accordance with the conception.

In chemical reactions the tendency is for the most stable combinations to be formed, so in nature.

We may probably go farther and say, not

only will the most stable biological molecules be formed, but the most stable radicles will dominate the molecule. Hence, if any two animals are crossed and the offspring show alternate inheritance, the resulting organism will, in the case of each unit character, display the most stable of the pair; in other words, it will take after the parent which happens to have the greater stability as regards that particular character. The difference between the mule and the hinny would seem to be explicable on this supposition. If the union were like a simple chemical synthesis it should not make any difference which way the cross were made. But if the species crossed are of varying stability, and if their respective degrees of stability vary with the sex, it is easy to see that it will make a difference how the animals are crossed.

In the cases of creatures that obey Mendel's law, the most stable form of a unit character will presumably be the dominant one.

One of the most curious of the phenomena of inheritance is that of correlation. We shall deal with this more fully in Chapter VIII. It will suffice here to say that certain characters appear to be linked together in organisms. Such seem to be transmitted in pairs. The offspring never exhibits one of such a correlated couple without exhibiting the other also.

It would thus seem that certain combinations

of biological atoms, certain molecules, can only exist in conjunction with certain other combinations. This is quite in accordance with the teaching of physiologists regarding the interdependence of the various organs of the body. We have now reached the stage of the fertilised ovum. According to our conception it is a series or conglomeration of the precursors of the unit characters of the adult. These precursors we call biological molecules. Each is of a very complex nature. Each seems to be composed of several portions, only one of which will take part in the building up of the body of the offspring, the other portions remaining latent. We further conceive that it is possible for the various radicles which compose these molecules to arrange themselves in various manners, and with each new arrangement a different form of unit character will be developed. These molecules, then, are built up from radicles derived from both parents, the most stable combinations being formed and one portion of the molecule dominating the whole. Under normal circumstances this dominant portion of the molecule will give rise to a character of a definite type. But it seems that other factors may come into play and cause a rearrangement of the radicles which compose it, and this will result in the formation of a unit character different from that to which it would ordinarily give rise.

But, it may be objected, if the colour of an organism be derived from one of these so-called biological molecules, how is it that it affects the whole organism, or, at any rate, several of the other unit characters? The objection may be met in several ways. In the first place, the colour-forming molecules may split up into as many portions as there are units which it affects, and each portion may attach itself to a unit. Or the property which we call colouration may not be derived from a molecule, it may be an expression in the relative positions of the various molecules in the fertilised egg. Or the colour-determining molecule may secrete a ferment or a hormone, and this may be the cause of the particular colouring of the resulting organism. We do not pretend to say which (if any) of these alternative suppositions is the correct one. But it seems to us that some such conception as that which we have set forth is forced upon us by observed facts. This conception should be regarded not as a theory, but rather as an indication of the lines along which we believe the study of inheritance could best be made.

The fertilised ovum has nothing of the shape of the creature to which it will give rise. It is merely a potential organism, a something which under favourable conditions will develop into an organism.

In the higher animals each individual is either

of the male or the female sex. A vast amount of ingenuity has been expended by zoologists in the attempt to ascertain what it is that determines sex. Many theories have been advanced, but no one of them has obtained anything like general acceptance, because its opponents are able to adduce facts which appear to be incompatible with it.

It is tempting to try to interpret the phenomenon of sex on the assumption that the female-producing biological molecule or unit is an isomeride of the male-producing cell. Certain facts, however, seem to negative the idea, as, for example, the occasional appearance in an individual of one sex of characteristics of the other sex.

Possibly the attempts to explain the phenomena of sex-production on a Mendelian basis may prove to be more successful. It seems not impossible that each fertilised egg contains material which is capable of developing into male generative organs and material which is capable of developing into female generative organs, but that only one kind of material, that which dominates, succeeds in developing. The number of what are known as "X-elements" that happen to be present in the fertilised egg appear to decide which kind of material is to be dominant.

But the problem of the determination of sex,

fascinating though it be, is not one that can be discussed adequately in a general work on evolution. Those interested in the subject are referred to Professor Thomson's *Heredity*, and to the address given by Professor E. B. Wilson, of Columbia University, before the American Association for the Advancement of Science, which was fully reported in the issue of *Science*, dated January 8, 1909.

Stated briefly, then, our conception is, that the fertilised egg is composed of a number of entities, to which we have given the name "biological molecules," because in certain respects their behaviour is not unlike that of chemical molecules.

The units which compose these molecules, being made up of protoplasm, are endowed with all the properties of life, including the inherent instability which characterises all living matter.

We suggest that the continuous or fluctuating variations that appear in the adult organism may be the result of individual differences in the biological "atoms" that compose the molecule.

Discontinuous variations, or mutations, on the other hand, may be the result of a rearrangement of the atoms within the biological molecule. Upon what causes this rearrangement it would not be very profitable to speculate in the present state of our knowledge. To do this would be to inquire into the cause of a re-grouping of entities

of the existence of which we are not certain! For aught we know there may be an intracellular struggle for nourishment among the various molecules and among the atoms which compose the molecules. If one molecule enjoys any special advantage over the others the result may be an unusual degree of development of the resulting unit character; in other words, the result will be a variation in the organism. This variation may prove favourable or unfavourable to its possessor.

Certain phenomena seem to point to a struggle for nourishment between the germinal and the somatic portions of the egg, between the parts from which the sexual cells of the resulting organism are produced and those which give rise to the body of the organism. Each molecule may strive, so to speak, to increase at the expense of the others. Thus, great size in an organism is likely to be produced at the expense of the germinal cell-forming molecules. In other words, great size in an organism would be incompatible with excessive fecundity. This is what we observe in nature. On the other hand, poor development of bodily tissue, as in the case of intestinal parasites, would be correlated with great fecundity. Some organisms are mere sacs full of eggs.

Success in the struggle for nourishment of one molecule might be shared by the other molecules near to it, hence the phenomena of correlation.

It is thus conceivable that, in a brood consisting of several individuals, a particular molecule or set of molecules in one of the individuals may receive more than its share of nourishment, and this will result in the organs of that individual which spring from the well-nourished molecules being exceptionally well developed. Thus arises the phenomenon of differences between the members of a litter or brood.

Natural selection will tend to eliminate those individuals in which the resulting variation is an unfavourable one. If the environment is such, as in the case of an internal parasite, that the production of germ cells is the most necessary function of the organism, then those individuals in which the germ-forming molecules increase at the expense of the body-forming ones will tend to be preserved. This would cause the phenomenon which biologists term degeneration. The nourishment of the various biological molecules may possibly depend on their relative positions in the egg. Those in a favourable position will then tend to develop at the expense of the others. This will result in variation along definite lines. Each succeeding generation will tend to an increased development of that particular organ to which the favourably-situated molecule gives rise. This process may continue, as in the case of the horns of the Irish elk, until the development of that particular organ becomes

so excessive as to be positively injurious; then natural selection will step in and eliminate the species. But before this happens, something may cause a rearrangement of the biological molecules in the fertilised egg, and thus a mutation may arise, which, so to speak, strikes out a new line.

Finally, on this conception there may be some sort of connection between fluctuating variations and mutations. We can picture the fluctuating variations being piled up, one upon the other, until there results a rearrangement of the atoms in one or more of the biological molecules which, in turn, causes a mutation.

Occasionally this remodelling, as it were, of one biological molecule may affect certain of the other molecules, and thus lead to correlated mutations.

CHAPTER VI

THE COLOURATION OF ORGANISMS

The theory of protective colouration has been carried to absurd lengths—It will not bear close scrutiny—Cryptic colouring—Sematic colours — Pseudo-sematic colours — Batesian and Müllerian mimicry—Conditions necessary for mimicry—Examples—Recognition markings—The theory of obliterative colouration—Criticism of the theory—Objections to the theory of cryptic colouring—Whiteness of the Arctic fauna is exaggerated—Illustrative tables—Pelagic organisms—Objectors to the Neo-Darwinian theories of colouration are to be found among field naturalists—G. A. B. Dewar, Gadow, Robinson, F. C. Selous quoted — Colours of birds' eggs — Warning colouration — Objections to the theory — Eisig's theory — So-called intimidating attitudes of animals—Mimicry—The case for the theory—The case against the theory—"False mimicry"—Theory of recognition colours—The theory refuted —Colours of flowers and fruits—Neo-Darwinian explanations —Objections—Kay Robinson's theory—Conclusion that Neo-Darwinian theories are untenable—Some suggestions regarding the colouration of animals — Through the diversity of colouring of organisms something like order runs—The connection between biological molecules and colour—Tylor on colour patterns in animals — Bonhote's theory of pœcilomeres—Summary of conclusions arrived at.

SINCE the publication of *The Origin of Species*, naturalists have paid much attention to the colouration of animals and plants, with the result that a large majority of scientific men to-day hold the belief that all, or nearly all, the colours displayed

by animals are of direct utility to them, and are therefore the direct result of natural selection; a few would add, "and of sexual selection."

"Among the numerous applications of the Darwinian theory," writes Wallace, "in the interpretation of the complex phenomena, none have been more successful than those which deal with the colours of animals and plants."

We readily admit that the Darwinian theory has thrown a great deal of light on the phenomenon of animal colouration; it has reduced to something like order what was before Darwin's time chaos. While admitting this we feel constrained to say that many naturalists, especially Dr Wallace and Professor Poulton, have pushed the various theories of animal colouration to absurd lengths. As Dr H. Robinson truly says (*Knowledge*, January 1909), "It seems to have been taken for granted, and some even of Dr Wallace's writings may be interpreted in this sense, that protective colouring is necessary to the continued existence of every species, and that, sexual colouration apart, it is incumbent on naturalists to offer ingenious speculations in this sense to account for the appearance even of the most bizarre and conspicuous beasts. Thence it has been but a short step to the announcement of those speculations as further evidence in favour of natural selection, and of various assumptions

made in the speculative process as indisputable facts."

The result of this is that men have ceased to regard the Neo-Darwinian [1] theories of protective colouration, mimicry, and recognition markings as mere hypotheses which seem to throw light on certain phenomena in the organic world. These theories have assumed the rank of laws of nature. To dispute them would seem to be as futile as to assert that the earth is flat. To take exception to them would appear to be as ridiculous as to object to Mont Blanc. To dare to criticise them is heresy of the worst type.

Be this as it may, scientific dogma or no scientific dogma, scientific opinion or no scientific opinion, we have dared to weigh these theories in the balance of observation and reason, and have found them wanting. We have examined these mighty images of gold, and silver, and brass, and iron, and found that there is much clay in the feet.

We shall devote this chapter to lifting the hem of the garment of sanctity that envelopes each of these images, and so expose to view the clay that lies concealed.

We propose, first, to set forth in outline what

[1] In this chapter we use the word Neo-Darwinism in its usually-accepted sense, *i.e.* as a name for that which should be called Wallaceism, for the doctrine of the all-sufficiency of natural selection.

we trust will be considered a fair statement of the various theories of animal colouration which are generally accepted to-day, then to show up the various weak points in these, and lastly, to endeavour to ascertain whether there are not some alternative explanations in certain cases to which the generally-accepted theory does not apply.

Neo-Darwinians divide the various forms of colouration into three great classes:—(1) Cryptic colouring, or protective and aggressive resemblances; (2) sematic colours, or warning and recognition colours; and (3) pseudo-sematic colours, or mimicry. A tabular statement of this scheme of colouring will be found on pp. 293-7 of Professor Poulton's *Essays on Evolution.*

As regards class (1), Neo-Darwinians point out that the great majority of animals are so coloured as to make them very difficult to see in their natural environment, hence the whiteness of the creatures which inhabit the snow-bound Arctic regions, the sandy colour of desert animals, the spotted coats of creatures which live among trees, the striped markings of animals which spend their lives amid long grass, and the transparent blueness of pelagic animals. The theory is that all kinds of animals, whether those that hunt or those that are hunted, derive much advantage from being coloured like their environ-

ment. The hunted creatures are thereby the better able to elude the vigilance of their foes, while those that hunt are in a position to take their quarry by surprise; so that natural selection has caused them all to assimilate to the hues of their surroundings. Neo-Darwinians point to the fact that some Arctic animals are brown in the summer to match the ground from which the snow has melted, and turn white in winter to assimilate with their snowy background. Naturalists further cite, as evidence in favour of this theory, the case of those creatures which imitate inanimate objects, such as leaves and twigs, and thereby escape the observation of their foes.

Thus, the great majority of animals are supposed to be cryptically coloured, that is to say, coloured so as to be, if not quite invisible, at least very inconspicuous in their natural habitat.

It is, however, generally admitted that many creatures are not cryptically coloured. Some, indeed, seem to be coloured in such a way as to render them as conspicuous as possible. The Neo-Darwinians declare that there is a reason for this. "If," writes Professor Milnes Marshall (page 133 of his *Lectures on the Darwinian Theory*), "an animal, belonging to a group liable to be eaten by others, is possessed of a nauseous taste, or if an animal, such as a wasp, is specially

armed and venomous, it is to its advantage that it should be recognised quickly, and so avoided by animals that might be disposed to take it as food.

"Hence arises warning colouration, the explanation of which is due to Wallace. Darwin, who was unable to explain the reason for the gaudy colouration of some caterpillars, stated his difficulty to Wallace, and asked for suggestions. Wallace thought the matter over, considered all known cases, and then ventured to predict that birds and other enemies would be found to refuse such caterpillars if offered to them. This explanation, first applied to caterpillars, soon extended to adult forms, not only of insects, but of other groups as well. . . . Insects afford many admirable examples of warning colours, and many well-known instances occur among butterflies. The best examples of these are found in three great families of butterflies—the *Heliconidæ*, found in South America, the *Danaidæ*, found in Asia and tropical regions generally, and the *Acræidæ* of Africa. These have large but rather weak wings, and fly slowly. They are always very abundant, all have conspicuous colours or markings, and often a peculiar form of flight, characters by which they can be recognised at a glance. The colours are nearly always the same on both upper and under surfaces of the wings; they never try to conceal

themselves, but rest on the upper surfaces of leaves and flowers. Moreover, they all have juices which exhale a powerful scent; so that, if they are killed by pinching the body, a liquid exudes which stains the fingers yellow, and leaves an odour which can only be removed by repeated washing. This odour is not very offensive to man, but has been shown by experiment to be so to birds and other insect-eating animals.

"Warning colours are advertisements, often highly coloured advertisements, of unsuitability as food. Insects are of two kinds—those which are extremely difficult to find, and those which are rendered prominent through startling colours and conspicuous attitudes. Warning colours may usually be distinguished by being conspicuously exposed when the animal is at rest. Crude patterns and startling contrasts in colour are characteristically warning, and these colours and patterns often resemble each other; black combined with white, yellow, or red, are the commonest combinations, and the patterns usually consist of rings, stripes, or spots."

We trust that we shall be forgiven for this lengthy quotation. Our object in reproducing so large an extract is to allow the Neo-Darwinians to speak for themselves. Were we to state their theory in our own words, we might perhaps be charged with stating it inaccurately. We should

add that, even as natural selection is supposed to have been the cause of conspicuous colouring in some organisms, so has it caused others to assume intimidating attitudes or emit warning sounds, such as a hiss, when attacked.

We now come to the third great class of animal colours—mimetic colours. Mimicry is of two kinds, known respectively as Batesian and Müllerian mimicry, after their respective discoverers.

It has been found that some apparently warningly coloured butterflies and other creatures are palatable to insectivorous animals. The explanation given of this is that these showy but edible butterfles "mimic," that is to say, have the appearance of, show a general resemblance to, species which are unpalatable. This is known as Batesian mimicry. "Protective mimicry," writes Professor Poulton (*Essays on Evolution*, p. 361), "is here defined as an advantageous superficial resemblance of a palatable defenceless form to another that is specially defended so as to be disliked or feared by the majority of enemies of the groups to which both mimic and model belong—a resemblance which appeals to the senses of animal enemies . . . but does not extend to deep-seated characters, except when the superficial likeness is affected thereby."

As Wallace has pointed out, five conditions

must be satisfied before such protective mimicry can occur :—

"1. That the imitative species occur in the same area and occupy the same station as the imitated. 2. That the imitators are always the more defenceless. 3. That the imitators are always less numerous in individuals. 4. That the imitators differ from the bulk of their allies. 5. That the imitation, however minute, is external and visible only, never extending to internal characters or to such as does not affect the external characters." (*Darwinism*, Chap. ix.).

Thus the mimic is supposed to deceive his enemies by deluding them into the belief that he is the inedible species which they once tried to eat and vowed never again to touch, so nasty was it. The mimic, then, may be compared to the ass in the lion's skin. Needless to say, this mimicry is quite unconscious. It is supposed to have been developed by natural selection. Every popular book on Evolution cites many examples of such mimicry. We may therefore content ourselves with mentioning but a few.

Our common wasps are copied by a beetle (*Clytus arietis*), active in movement and banded black and yellow, and by several yellow-barred hover-flies (*Syrphidae*); and the bumble-bee by a clear-winged moth (*Sesia fuciformis*).

There is, indeed, a whole group of these clear-winged moths, resembling bees, wasps, and other stinging hymenoptera. The common Indian Danaid butterfly, *Danais chrysippus*, is marvellously reproduced by the female of *Hypolimnas misippus*, a form allied to our Purple Emperor. The male of this is black, with white blue-bordered patches, the female chestnut, edged with black and with white spots at the tips of the wings, as in the *Danais*. Finn has shown experimentally that this species is liked by birds.

Another common Indian Danaid (*D. limniace*), black, spotted with pale green, is imitated, though not very closely, by the female of one of the "white" group, *Nepheronia hippia*. Finn found that this insect was eaten freely by birds, and that the common jungle-babbler (*Crateropus canorus*) was deceived by the mimicry of the female. The very nauseous Indian swallow-tail (*Papilio aristolochiæ*) is closely imitated by another swallow-tail (*P. polites*), both having black wings marked with red and white; *P. aristolochiæ*, however, has a red abdomen. This difference was not noticed by two species of Drongo-shrikes (*Dicrurus ater* and *Dissemurus paradiseus*), to which the butterflies were offered; but the Pekin robin (*Liothrix luteus*)—a very intelligent little bird—did not fail to pick out and eat the mimic, though it was deceived by the marvellously

perfect imitation of *Danais chrysippus*, by the female of the *Hypolimnas*.

Such resemblances can therefore be effective.

The cases of mimicry usually quoted include very few among mammals, probably, as Beddard suggests, because the species of that class are relatively few.

The insectivorous genus *Tupaia* is supposed to mimic the squirrels, which it much resembles as regards form in all respects save the long muzzle; the idea being that squirrels are so active that carnivorous animals find it hopeless to pursue them.

On the other hand, there is a squirrel (*Rhinosciurus tupaioides*) which is supposed to mimic the tupaias! It has a similar long muzzle, and the light shoulder-stripe which is a common marking in tupaias. But why the squirrel, one of the group imitated, should in turn become an imitator is not explained.

The true interpretation of the resemblance is probably that both squirrels and tupaias are adapted to a life in trees. Like profession begets like appearance: the ground-living shrews much resemble mice, and the moles find representatives in mole-like rodents.

Another case, however, wherein true mimicry may have come into play is that of the South American deer (*Cervus paludosus*) which singularly resembles in colouration the long-legged

wolf or *Aguara-guazu* (*Canis jubatus*). Both these species are chestnut in colour, with the front of the legs black, and the ears lined with white hair; both inhabit the same regions in South America.

The second kind of mimicry—Müllerian mimicry—is where one unpalatable creature resembles another. This form of mimicry is named after Fritz Müller, who suggested the explanation now usually accepted, namely, that "Life is saved by a resemblance between the warning colours in any area, inasmuch as the education of young inexperienced enemies is facilitated, and insect life saved in the process." "It is obvious," writes Poulton (p. 328 of *Essays on Evolution*), "that the amount of learning and remembering, and consequently of injury and loss of life involved in these processes, are reduced when many species in one place possess the same aposematic colouring, instead of each exhibiting a different danger signal. . . . The precise statement of advantage was made by Mr Blakiston and Mr Alexander, of Tokio. 'Let there be two species of insects equally distasteful to young birds, and let it be supposed that the birds would destroy the same number of individuals of each before they were educated to avoid them. Then if these insects are thoroughly mixed and become undistinguishable to the birds, a proportionate advantage accrues to each over its former state of existence.

These proportionate advantages are inversely in the duplicate ratio of the respective percentages that would have survived without the mimicry.'"

This is rather a cumbrous method of saying that if there are in a locality a number of young birds, and each of these has to learn by experience which insects are edible and which are not, each will, if it learns by one example, devour one insect of any given pattern. Now, if two species of inedible insects have this pattern, they will between them lose only one member in the educating process of each bird, whereas if each species of insect had a colouration peculiar to itself, each species would lose a whole individual instead of half a one. There can be no doubt that such a livery of unpalatability is of some advantage to its possessors.

It has been shown experimentally that hand-reared young birds have to acquire their knowledge of flavours and colours by experiment.

It is well known that in many species the male and the female are not coloured alike. Such species are said to exhibit sexual dimorphism. In these cases it is usually the male that is more conspicuously coloured. Darwin felt that the theory of natural selection could not satisfactorily account for this phenomenon, so put forward the supplementary theory of sexual selection. On this hypothesis the females are supposed to be able to pick and

choose their mates, and to select the most beautiful and ornamental ones, hence the greater showiness of these in most sexually dimorphic species. Wallace does not accept this theory. He thinks it unnecessary. He looks upon the brilliant colouring of the males as due to their superior vigour; moreover, he says that it is the hen that sits upon the eggs, and so requires a greater degree of protection than the male, and therefore natural selection has not permitted her to develop all the ornaments displayed by the cock. With the phenomenon of sexual dimorphism we shall deal at length in the next chapter.

Dr Wallace recognizes yet another exception to the rule that animals are cryptically coloured. Many creatures possess on the body markings which tend to render them conspicuous rather than difficult to see. Where such markings occur on gregarious animals, Wallace believes that they have been evolved by natural selection, either to enable their possessors to recognize one another, or to act as a danger signal to their fellows. The white tail of the rabbit is believed by Wallace to serve as a danger signal. The first member of the company to espy the approaching foe takes to his heels, and, as he moves, his white tail catches the eye of his neighbour, who at once follows him, so that, in less time than it takes to tell, the whole company of rabbits is

scampering towards the burrow, thanks to the white under-surface of the tail.

Even as Wallace out-Darwin's Darwin, so does Mr Abbott Thayer, an American naturalist and artist, out-Wallace Wallace. That gentleman seems to be of opinion that *all* animals are cryptically or, as he calls it, concealingly or obliteratively coloured. Even those schemes of colour which have hitherto been called conspicuous are, he asserts, "purely and potently concealing" when looked at properly, that is to say, with the eye of the artist.

Lest it be thought unnecessary to criticize a hypothesis which appears to be based upon the assumption that animals see with the eye of the artist, we may say that Professor Poulton writes approvingly of Thayer's theory. He frequently alludes to it in his *Essays on Evolution*, and he published an account of it in the issue of *Nature*, dated April 24, 1902. Moreover the hypothesis has been enunciated in such scientific journals as *The Auk* (1896) and *The Year-Book of the Smithsonian Institution* (1897).

Thayer asserts that all animals, or at any rate the great majority, including many that are usually supposed to be conspicuously coloured, are in reality obliteratively coloured—that is to say, coloured in such a way that the effects of light and shade are completely counteracted, with the result that they are invisible.

Obliterative Colouring

It is possible, says Mr Thayer, to almost obliterate a statue in a diffused light, by putting white paint on the surfaces in darkest shadow and dark paint on the most brightly lighted parts, all in due proportion. Now this is precisely what nature is supposed by Mr Thayer to have done for all her creatures.

It is well known that a great many animals, as for example the Indian black-buck and the hare, are coloured on the upper side and white below. This is called by Mr Thayer the principle of the gradation of colour. It runs, he declares, all through the animal world, and is "the main essential step toward making animals inconspicuous under the descending light of the sky."

Animals, he contends, are not protectively coloured to look like clods or stumps or like surrounding objects, they are simply obliteratively coloured—coated, as it were, with invisible paint.

To quote from *The Century Magazine* (1908): "Whales, lions, wolves, deer, hares, mice; partridges, quails, sandpipers, larks, sparrows; frogs, snakes, fishes, lizards, crabs; grasshoppers, slugs, caterpillars—all these animals, and many thousands more, crawl, crouch, and swim about their business, hunting and eluding, under cover of this strange obliterative mask, the smooth and perfect balance between shades of colour and degrees of illumination."

Nature having thus visually unsubstantialized the bodies of animals, so that, if seen at all, they look flat and ghostly, does not stop there. From solid-shaded bodies they have been converted, as it were, into flat cards or canvases, and, to complete the illusion of obliteration, pictures of the background—veritable pictures of the more or less distant landscape — have been painted on their canvases! Such in effect are the elaborate "markings of field and forest birds."

Again he writes: "Brilliantly changeable or metallic colours are usually supposed to make the birds that wear them conspicuous, but nothing could be further from the truth. Iridescence is, indeed, one of the strongest factors of concealment. The quicksilver-like intershifting of many lights and colours, which the slightest motion generates on an iridescent surface, like the back of a bird or the wing of a butterfly, destroys the visibility of that wing or back as such and causes it to blend inextricably with the gleaming and scintillating labyrinthine-shadowed world of wind-swayed leaves and flowers."

According to Thayer, the skunk, which for years has been an important item of the stock-in-trade of the advocates of the theory of warning colouration, is an excellent example of obliterative colouring, since its enemies are supposed to mistake for the sky-line the line of junction between

the white fur of the back and the dark fur of the sides. Similarly the crocodiles are supposed to mistake a flamingo for the sky at sunrise or at sunset!

There is doubtless something in this theory of obliterative colouration.

Any one can see, by paying a visit to the South Kensington Museum, that an animal which is of a lighter colour below than above, is less conspicuous in a poor light than it would be were it uniformly coloured. There is then no doubt that this scheme of colour, which is so common in nature, has some protective value.

To this extent has Mr Thayer made a valuable contribution to zoological science. But when he informs us that obliterative colouring is a "universal attribute of animal life," we feel sorely tempted to poke fun at him.

We would ask all those who believe in the universality of obliterative colouring to observe a flock of rooks wending their way to their dormitories at sunset.

Let us now pass on to the examination of the more orthodox theories of animal colouration.

Objections to the Theory of Cryptic Colouring

Before criticising the theory of cryptic colouring, we desire to state distinctly that we admit

that, where other things are equal, it is of advantage to all creatures which hunt or which are preyed upon to be inconspicuous. If difficult to distinguish amid their natural surroundings, the former are likely to secure their prey readily, and the latter have a chance of escaping from their enemies. Our quarrel is with the theory of cryptic colouring as it is enunciated by many Neo-Darwinians, with the theory that every hue, every marking, every device displayed by an organism is of utility to the organism and has been directly developed by natural selection.

The extreme advocates of the theory of cryptic colouring have greatly exaggerated the degree in which animals are assimilated to their natural environment.

We grant that a great many creatures, which when seen in a menagerie appear very conspicuous, are the reverse of conspicuous when standing motionless amid their natural surroundings. As Beddard has pointed out, it is often not easy to find a sixpenny piece which has been dropped on the carpet, but the reason for this is, not that the coin is protectively coloured, but that any small object, no matter how coloured, is difficult to distinguish amid a variegated environment. The assumption of a white winter coat by many organisms that live in northern latitudes has been cited, again and again, as showing how important it is for an

animal to be protectively coloured. If, it is urged, those creatures that live in lands which are covered in snow for half of the year have become white in winter by the action of natural selection in order to escape their foes, it is obviously of paramount importance to all creatures that they should be cryptically coloured. Popular books on natural history convey the impression that during winter the snow-clad, ice-bound Arctic regions are peopled by a fauna whose fur or hair rivals in whiteness the snowy mantle of the earth. The impression thus conveyed is misleading. It is true that an unusually large percentage of the animals that inhabit the polar regions are white in winter, but the majority of the creatures which dwell there do not assume the white garb of winter.

As the fauna of the polar regions is a small one, we are able to give lists of all the birds and mammals which dwell in the Arctic and the Antarctic regions. We have arranged these in in three columns. In the first are placed those creatures which are white throughout the year, in the third those that retain their colour through the winter, while the middle column contains those forms which change their colouring with the season.

ARCTIC FAUNA.

Mammals.		
White.	Changing with the Seasons.	Coloured.
Polar Bear. Arctic Fox (some individuals). White Whale or Beluga.	Arctic Fox (most individuals). Arctic Lemming. Stoat. Weasel. Blue Hare.	Arctic Fox (sometimes). Reindeer. Musk-ox. Glutton. Moose. Sable. Seals. Walrus. Narhwal. Greenland Whale.
Birds.		
Ivory Gull. Snowy Owl. Gyrfalcon. Snow Goose.	Black Guillemot. Ptarmigans. Snow Bunting (whitest in summer !). Razorbill. Little Auk (throat only becomes white).	Sea Eagle. Greenland Redpoll (very pale). All Arctic Geese and Ducks other than Snow Goose. Raven. Cormorant. Brunnich's Guillemot. Puffin. Fulmar Petrel. Ross's Gull. Glaucous Gull (very pale). Sandpipers.

ANTARCTIC FAUNA.

Mammals.		
White.	Changing with the Seasons.	Coloured.
Antarctic White Seal (*Lobodon carcinophaga*), in some cases.	None.	Other Seals than *Lobodon*. Whales.
Birds.		
Sheathbill. Snowy Petrel. Giant Petrel (some individuals). Chick of Emperor Penguin.	None.	Penguins. Cormorant. Skua Gull. Giant Petrel (usually). Other Petrels.

It will be observed that the third column contains the largest number of forms. It is thus evident that the whiteness of the Arctic and Antarctic faunas in winter has been greatly exaggerated.

The Arctic fox appears in all three columns, as the creature seems to fall into three races—a permanently white race, a permanently coloured race, and a seasonally dimorphic race.

Of the creatures set forth in the middle column of the above tables all are whiter in winter than in summer with the exception of the snow bunt-

ing, who sets at naught the theory of cryptic colouring by turning darker in winter! The same may be said of the Alpine chamois.

The advocates of the theory of protective colouring assert that the creatures which do not turn white in winter are strong and active animals which have no enemies to fear.

This contention is met by F. C. Selous as follows (*African Nature Notes and Reminiscences*, p. 9): "According to the experience of Arctic travellers, large numbers of young musk oxen are annually killed by wolves. . . . Nothing, I think, is more certain than that a far smaller percentage of so-called protectively coloured giraffes are killed annually by lions in Africa than of musk oxen by wolves in Arctic America."

Another difficulty which confronts the Neo-Wallaceian school is that, *ex hypothesi*, the assumption of the white coat was gradual. Hence the change in the direction of whiteness cannot, in its first beginning, have been of perceptible utility to an organism. How then can natural selection have operated on it?

The transparency of pelagic organisms is frequently cited as exemplifying cryptic colouring. We all know that the common jelly-fish is as transparent as glass. Floating on the surface of the ocean are millions of tiny organisms, so transparent as to be invisible to the human eye. At first sight this certainly appears to be a

remarkable case of protective colouring. Unfortunately, nearly all the more highly developed forms display conspicuous pigment (as in most jelly-fish) in some part of the body.

"An animal floating about in the sea," writes Beddard, "perfectly transparent, but decked with dense black patches, of the size of saucers, would betray its whereabouts even to the least observant; if the observer were stimulated by hunger or fear, the conspicuousness would not be lessened. . . . Besides the internecine warfare which is continually going on amongst the smaller surface organisms, they are devoured wholesale by the larger pelagic fish, and by whales and other Cetacea. A whale, rushing through the water with open mouth and gulping down all before him, is not the least inconvenienced by the invisibility of the organisms devoured in such enormous quantities; nor do a solid phalanx of herring or mackerel stop to look carefully for their food: they take what comes in their way, and get plenty in spite of 'protective absence of colouration.'

"If the transparency of the pelagic organisms be due entirely to natural selection, it is remarkable that there is so little modification in this direction among the species inhabiting the bottom at such depths as are accessible to the sun's rays; the advantage gained by this transparency and consequent invisibility would be equally great. And

yet this is not the case; the bulk of the bottom fauna of the coasts are brilliantly coloured animals, and those that show any protective colouring at all appear to be coloured so as to resemble stones or sea-weeds." [1]

Before leaving the subject of marine animals, we may point out that the majority of the creatures that live in the everlasting blackness of the depths of the ocean display exceedingly conspicuous colouring, and this colouring seems to be constant. In such cases the colouring cannot be useful as such to its possessors. The same may be said of the colour of blood, or of the colouring of the internal tissues of all organisms. We must not lose sight of the fact that every organism, and every component part thereof, must of necessity be either of some colour or perfectly transparent. It seems to us that since the appearance of *The Origin of Species* zoologists have tended to exaggerate the importance of colouring to organisms; they frequently speak of it as though it were the one and only factor in the struggle for existence. It is on this account that they feel it incumbent upon them to find ingenious explanations for every piece of colouring displayed by every plant or animal.

The tendency to exaggerate the importance to an animal of its colouring is doubtless in large

[1] *Animal Colouration*, p. 125. A book full of valuable facts and ideas on this most interesting subject.

part due to the fact that many zoologists are content to study nature in museums rather than in the open. Some of those who observe organisms in their natural surroundings, especially in such favourable localities as the tropics, seem to be of opinion that natural selection has but little influence on the colouration of organisms.

Thus D. Dewar writes (*Albany Review*, 1907): "Eight years of bird-watching in India have convinced me that, so far as the struggle for existence is concerned, it matters not to a bird whether it be conspicuously or inconspicuously coloured, that it is not the necessity for protection against raptorial foes which determines the colouring of a species; in short, that the theory of protective colouration has but little application to the fowls of the air."

Similarly, F. C. Selous writes, on page 13 of *African Nature Notes and Reminiscences*: "Having spent many years of my life in the constant pursuit of African game, I have certainly been afforded opportunities such as have been enjoyed by but few civilised men of becoming intimately acquainted with the habits and life-history of many species of animals living in that continent, and all that I have learned during my long experience as a hunter compels me to doubt the correctness of the now very generally accepted theories that all the wonder-

fully diversified colours of animals—the stripes of the zebra, the blotched coat of the giraffe, the spots of the bushbuck, the white face and the rump of the bontebok, to mention only a few—have been coloured either as means of protection from enemies or for the purpose of mutual recognition by animals of the same species in times of sudden alarm."

So also G. A. B. Dewar — a very close observer of nature in England—writes, in *The Faery Year*: "Few theories in natural history have received more attention of late years than protective or aggressive colour, 'mimicry,' and harmony with environment. . . . To doubt this use of colour to animals seems like inviting back chaos in place of cosmos—for abandon the theory, and a world of colour is straightway void of purpose, a muddle of chance. So we all like the theory. Some, however, perceive plans to aid the wearer in every colour, tint, shade, and pattern. We may be sceptical of a good many of the cases they cite in support of colour aid, though attracted by the main idea."

Writing of the commoner British butterflies, he says: "After a little practice, any man furnished with good eyesight can easily distinguish these butterflies—blues, coppers, small heaths, and meadow browns—from their perches; and so we may be sure that the small beast, bird, or insect of prey, with sense of colour or form,

could also distinguish them. . . . Quite often, without even searching for them, I can see cabbage whites and other butterflies asleep on perches to which they by no means assimilate." Mr G. A. B. Dewar suggests that the safety of the resting butterfly lies in "the position, the couch on high, . . . not the mask of colour or marking."

Two short visits to Southern Mexico sufficed to show Dr Hans Gadow that some of the commonly accepted explanations of colour phenomena are not the correct ones.

Thus writing of coral snakes, he says, on page 95 of *Through Southern Mexico*: "They are usually paraded as glaring instances of warning colouration, but I am not at all sure whether this is justifiable. Certainly these *Elaps* are most conspicuous and beautiful objects. Black and carmine or coral red, in alternate rings, are the favourite pattern; sometimes with narrow golden-yellow rings between them, as if to enhance the beautiful combination. But these snakes are inclined to be nocturnal in their habits, and, except when basking, spend most of their time under rotten stumps, in mouldy ground, or in ants' nests in search of their prey, which must be very small, to judge from the size of the mouth."

Dr Gadow goes on to show that although black and red are very strong contrasts in the

day-time, the combination ceases to be effective in the dark. He suggests that red and black is a self-effacing rather than a warning pattern. He further points out that several kinds of harmless snakes have the same colouring and pattern. "There seems," he says, "to be no reason why we should not call these cases of mimicry; and yet this is most likely a wrong interpretation, since such harmless snakes are also found in districts where the *Elaps* does not occur, not only in Mexico, but likewise in far-distant parts of the world, where neither elapines nor any other similarly coloured poisonous snakes exist. To interpret this as an instance of 'warning colours' in a perfectly harmless snake, which has no chance of mimicry, amounts in such cases to nonsense, and we have to look for a different explanation upon physiological and other grounds."

It is, to say the least of it, significant that all the opposition to the theory of protective colouration comes from those who observe nature first hand, while the warmest supporters of the theory are cabinet naturalists and museum zoologists.

In the case of nocturnal creatures, as Dr H. Robinson very sagely points out (*Knowledge*, January 1909), the value for protective purposes of any given colouration must depend very largely on the state of the moon. "It was," he writes, "a common experience in the South

African War that on overcast or moonless nights the nearly black army great-coat made a picquet sentry invisible at a distance of a few feet. In strong moonlight this garb could be seen at a great distance, whereas a khaki pea jacket, useless on a dark night, answered the requirements of invisibility very well." It is thus evident that the dark colour of the buffalo and sable antelope cannot be protective on both dark and moonlight nights.

The theory of protective colouration is based on the tacit assumption that beasts of prey rely on eyesight for finding their quarry. Raptorial birds certainly do use their eyes as the means of discovering their victims; but the great majority of predaceous mammals trust almost entirely to their power of smell as a means for tracking down their prey.

"Nothing," writes F. C. Selous, on page 14 of *African Nature Notes and Reminiscences*, "is more certain than that all carnivorous animals hunt almost entirely by scent until they have closely approached their quarry, and usually by night, when all the animals on which they prey must look very much alike as far as colour is concerned."

The herbivora—the quarry for the beast of prey—too, have a keen sense of smell, so that they trust their noses rather than their eyes for safety.

No observer of nature can have failed to remark how the least movement on the part of an animal will betray its whereabouts, even though in colouring it assimilates very closely to the environment. So long as the hare squats motionless in the furrow, it may remain unobserved, even though the sportsman be searching for it; but the least movement on its part at once attracts his eye. Thus, in order that protective colouration can be of use to its possessor, the latter must remain perfectly motionless. But, in tropical countries, where flies, gnats, etc., are a perfect scourge, no large animal is, when awake, motionless for ten seconds at a time. The tail is in constant motion, flicking off the flies that attempt to settle on the quadruped. The ears are used in a similar manner. Thus the so-called protective colouring of herbivora cannot afford them much protection. It is further worthy of note that the brush-like tip to the tail of many mammals is not of the same colour as the skin or fur. It is very frequently black. Thus we have the spectacle of a protectively coloured creature continually moving, as if to attract attention, almost the only part of its body that is not protectively coloured!

Many species of birds display what is known as seasonal dimorphism, still more display sexual dimorphism.

Seasonally dimorphic birds very often assume

a bright livery at the breeding season; this nuptial plumage is by no means invariably confined to the cock, so that we are brought face to face with the fact that some hen birds, that are normally inconspicuously coloured, become showy and easy to see at the nesting time, that is to say, precisely at the season when they would seem to be most in need of protection.

In the great majority of cases of sexual dimorphism among birds the cock is the more showily coloured. Now, if it be a matter of life-and-death importance to a bird to be protectively coloured, we should expect the showily coloured cock birds to be far less numerous than the dull-plumaged hens, since the former are, *ex hypothesi*, exposed to far greater danger than the inconspicuous hens. As a matter of fact, cock birds in practically all species appear to be at least as numerous as the hens. Nor can it be said that this is due to their more secretive habits. As a general rule, cock birds show themselves as readily as the hens; indeed, in the case of the familiar blackbird, the conspicuous cock is less retiring in his habits than the more sombre hen. It may, perhaps, be thought that the greater danger to which the sitting bird is exposed accounts for the fact that hens, notwithstanding their protective colouration, are not more numerous than the cocks. Unfortunately for the supposition, in many sexually dimorphic

hens, as, for example, the paradise fly-catcher (*Terpsiphone paradisi*), the showy cock shares the burden of incubation equally with the hen.

It frequently happens that allied species of birds are found in neighbouring countries. The Indian robins, for example, fall into two species. The brown-backed robin (*Thamnobia cambayensis*) occurs north of Bombay, while the black-backed species (*T. fulicata*) is found south of Bombay. The hens of these two species are almost indistinguishable, but the cocks differ, in that one has a brown back, while the other's back is glossy black. The Wallaceian theory of colouration seems quite unable to explain this phenomenon—the splitting up of a genus into local species—which is continually met with in nature. Equally inimical to the theory of protective colouration is the existence, side by side, of species which obtain their living in much the same manner. On every Indian lake three different species of kingfisher pursue their profession cheek by jowl; one of these—*Ceryle rudis*—is speckled black and white, like a Hamburg fowl; the second is the kingfisher we know in England; and the third is the magnificent white-breasted species—*Halcyon smyrnensis*—a bright-blue bird with a reddish head and a white wing bar. It is obvious that all three of these diversely plumaged species cannot be protectively coloured. It may perhaps be objected that the piscatorial methods

of these kingfishers differ in detail. We admit that this is the case, but would maintain, at the same time, that these comparatively slight differences in habit do not account for the very striking differences in plumage. We may also cite the yellow and pied wagtails of our own country, which may be seen feeding in the same meadows. Most familiar and striking of all is the everyday sight of a blackbird and thrush plying their respective avocations within a few yards of each other on the same lawn, differently coloured though they be.

Another weighty objection to the generally accepted theory of protective colouration is that some of the creatures which assimilate most closely to their environment are those which appear to be the least in need of such protection.

The butterfly *Precis artexia*, writes F. C. Selous, "is only found in shady forests, is seldom seen flying until disturbed, and always sits on the ground amongst dead leaves. Though handsomely coloured on the upper side, when its wings are closed it closely resembles a dead leaf. It has a little tail on the lower wing, which looks exactly like the stalk of a leaf, and from this tail a dark-brown line runs through both wings (which on the under side are light brown) to the apex of the upper wing. One would naturally be inclined to look upon this wonderful resemblance to a dead leaf in a butterfly sitting with closed wings

on the ground amongst real dead leaves as a remarkable instance of protective form and colouration. And of course it may be that this is the correct explanation. But what enemy is this butterfly protected against? Upon hundreds of different occasions I have ridden and walked through forests where *Precis artexia* was numerous, and I have caught and preserved many specimens of these butterflies, but never once did I see a bird attempting to catch one of them. Indeed, birds of all kinds were scarce in the forests where these insects were to be found."

Similarly D. Dewar writes (*Albany Review*, 1907): "If a naturalist be asked to cite a perfect example of protective colouring, he will, as likely as not, name the sand grouse (*Pteroclurus exustus*). This species dwells in open, dry, sandy country, and its dull brownish-buff plumage, with its soft dark bars, assimilates so closely to the sandy environment as to make the bird, when at rest, practically invisible, at any rate to the human eye. Unfortunately for the theory, this bird stands less in need of protective colouration than any other, for it has wonderful powers of flight. Even a trained falcon is unable to catch it, because it can fly upwards in a straight line as though it were ascending an inclined plane, with the result that the pursuing hawk is never able to get above it to strike."

Striped Caterpillars

Lord Avebury, who is a typical Wallaceian, points out the connection that exists between longitudinal stripes on caterpillars and the habit of feeding either on grass or low-growing plants among grass. The inference, of course, is that birds mistake these caterpillars for leaves, or, at any rate, fail to observe them when feeding, not only because they are green in colour, but because their longitudinal stripes look like the parallel veins on the blades of grass. But the butterflies of the family *Satyridæ*, as Beddard points out, *all* possess striped larvæ, and these feed chiefly by night, when neither their colouring nor marking is visible, while during the day many of them lie up under stones; other caterpillars of this family feed inside the stems of plants. "Now," writes Beddard (*Animal Coloura-tion*, p. 101), "in these cases the colour obviously does not matter: if, therefore, the longitudinal striping is kept up by constant selection on account of its utility, and has no other significa-tion, we might expect that in these two species (*Hipparchia semele* and *Œnis*), and in others with similar habits, the cessation of natural selection would have permitted the high standard required in the other cases to be lowered—perhaps, even, as has been suggested in the case of cave animals, the colours being useless to their possessors, might have disappeared altogether—but they have not."

Many exceedingly conspicuous birds—as, for example all the crow-tribe, the egrets, the kingfishers—flourish in spite of their showy plumage. Such creatures, while scarcely constituting a valid objection to the theory of protective colouration, serve to show that protective colouring is not a necessity. An animal otherwise able to take care of itself can afford to dispense with cryptic colouration. "An ounce of good solid pugnacity is a more effective weapon in the struggle for existence than many pounds of protective colouration."

There used to live in the gardens of the Zoological Society of London a black cat belonging to the manager of one of the restaurants. This animal used to catch birds on the lawn. We believe that not even Mr Thayer will maintain that a black cat is cryptically coloured when stalking on a well-watered lawn! Nevertheless the nigritude of that cat did not prevent it securing a meal.

The case of birds' eggs furnish an excellent example of the lengths to which Wallace and his followers have pushed the theory of protective colouration.

D. Dewar maintains that it is possible to divide birds' eggs that are coloured, as opposed to those that are white, into two classes—those which are protectively coloured and those which are not. The former class includes all those

which are laid in shingle or on the bare ground, as, for example, the eggs of the ring-plover and the lap-wing.[1] He maintains that the variously coloured and speckled eggs that are laid in cup-shaped nests are not protectively coloured at all; he declares that they are usually very conspicuous when in the nest, and, moreover, it would be futile for them to be cryptically coloured, for a bird or lizard that habitually sucks eggs will examine carefully the interior of each nest it discovers.

Needless to say, this view does not appeal to the so-called Neo-Darwinians. Wallace writes, on page 215 of *Darwinism*: "The beautiful blue or greenish eggs of the hedge-sparrow, the song-thrush, the blackbird, and the lesser redpole seem at first sight especially calculated to attract attention, but it is very doubtful whether they are really so conspicuous when seen at a little distance among their usual surroundings. For the nests of these birds are either in evergreen, or holly, or ivy, or surrounded by the delicate green tints of early spring vegetation, and may thus harmonise very well with the colours around them. The great majority of the eggs of our smaller birds are so spotted or streaked with brown or black on variously tinted grounds that,

[1] Even these eggs, closely though they resemble in colouring the shingle, etc., on which they are laid, are discovered and eaten by gulls, as Mr A. J. R. Roberts points out in *The Bird Book*.

when lying in the shadow of the nest and surrounded by the many colours and tints of bark and moss, of purple buds and tender green or yellow foliage, with all the complex glittering lights and mottled shades produced among these by the spring sunshine and sparkling rain-drops, they must have quite a different aspect from that which they possess when we observe them torn from their natural surroundings."

The obvious comment on this is that it is very fine and poetic English, but it is not science. It is futile to deny what should be obvious to every field naturalist, namely, that the majority of eggs laid in open nests are most conspicuous.

D. Dewar thus summarises the main facts which show that eggs in nests (as opposed to those laid on the bare ground) are not protectively coloured :—

"1. Allied species of birds, even though their nesting habits are very different, as a rule lay similarly coloured eggs.

"2. Eggs laid in domed nests certainly do not need protective colouring, yet many of these are coloured.

"3. The same is true of many eggs laid in holes in trees or in buildings.

"4. The protective resemblances of eggs which are laid in the open are apparent to everyone, which certainly is not true of those deposited in nests.

"5. Many birds lay eggs which exhibit very great variations.

"6. Some birds lay eggs of different types, and these sometimes differ from one another so greatly that it is difficult to believe that they could have been laid by the same species."[1]

7. It not infrequently happens that one species lays in the disused nest of another, and the eggs of the latter are often very different in colouring from those of the former.

We have up to the present considered the theory of general cryptic colouration, which declares that the majority of creatures are so coloured as to be inconspicuous. We have still to deal with the hypothesis of special cryptic colouring.

Certain animals look, when resting, very like an inanimate object, such as a dead leaf or a twig. This resemblance is said to be the result of natural selection, since it enables its possessors to escape destruction; they are seen, but mistaken for something else.

The classical examples of this kind of protective colouring are furnished by the *Kallimas* or leaf-butterflies, which display an extraordinary resemblance to dead leaves.

Other examples are the stick-insects and the lappet moth, which looks like a bunch of dry leaves. It is needless to multiply instances.

[1] *Journal of the Bombay Natural History Society*, Vol. xv. 1903-4), p. 454.

In every work on animal colouration numbers of such cases are cited.

We may grant that in some cases, at any rate, the resemblance is of value to its possessor, in that it deceives predatory creatures. But it does not follow from this that the likeness has originated through the action of natural selection. In order that there can be selection there must be varying degrees of a tolerable resemblance to select from. How did the initial similarity arise? This is a matter upon which Wallaceians are silent. As Poulton truly says, in discussing the degree of protection afforded by such resemblances, we tacitly endow animals with senses exactly similar to our own. Are we justified in so doing? Most certainly not in the case of the invertebrate animals, especially as regards the arthropods, of which the eyes are constructed very differently from those of human beings.

D. Dewar has often seen a toad shoot out its tongue and touch a lighted cigarette end, apparently mistaking it for an insect. Similarly, he has again and again induced a gecko lizard to chase and try to swallow a piece of black cotton, one end of which was rolled up into a ball. It is only necessary to take hold of the unrolled end of the cotton and place the rolled-up end a few inches from the lizard, and gradually draw it away in order to induce the lizard to attempt to seize it.

It would therefore seem that all these elaborate "protective" devices are unnecessary refinements if regarded as a protection against invertebrate, reptilian, and amphibian foes. Birds, on the other hand, appear to have exceedingly sharp eyesight, so that in order to deceive them the resemblance requires to be very close. Indeed, as regards those birds which systematically hunt for their prey among leaves and grass, it seems doubtful whether the alleged "protective" resemblances of caterpillars to twigs, etc., are sufficient to be of much use to them. Thus Beddard writes (on page 91 of *Animal Colouration*): "Judging of birds by our own standard—which is the way in which nearly all the problems relating to colour have been approached—does it seem likely that we should fail to see a caterpillar, perhaps as long or longer than the arm, of an obviously different texture from the branches, and displaying in many cases through its semi-transparent skin the pulsation of the heart, for which we were particularly searching?"

Now, birds certainly feed very largely on caterpillars, while they are but rarely seen to eat butterflies. If, therefore, the aim and object of these special resemblances is the protection of the species, we should expect to see them in a nearly perfect state in caterpillars on which birds feed very largely, and poorly developed in butterflies, which do not appear to be greatly

preyed upon by birds, but have to fear chiefly the comparatively dull-eyed lizards and mammals, of which the latter hunt mainly by scent. As a matter of fact, the most striking cases of resemblance to inanimate objects are seen among butterflies, which seem to stand least in need of them.

We have already cited the case of the butterfly *Precis artexia.* Even more marked does the unnecessary elaboration of the likeness seem to be in the Kallima butterflies.

The Theory of Warning Colouration

All biologists admit that there exist some organisms which are not coloured so as to be inconspicuous. Indeed, the colouring of certain species is such as to render them particularly conspicuous. Such species are said to be warningly coloured. They are supposed to be inedible, or to have powerful stings or other weapons of defence, or to resemble in appearance organisms which are thus protected. In the first two cases they are said to be warningly coloured, and in the last they are cited as examples of protective mimicry. With the theory of mimicry we shall deal shortly. We must first discuss the hypothesis of warning colouration.

When animals are unpalatable, or when they possess a sting or poison-fangs, it is, to use the

words of Wallace, "important that they should not be mistaken for defenceless or eatable species of the same class or order, since in that case they might suffer injury, or even death, before their enemies discovered the danger or the uselessness of the attack. They require some signal or danger-flag which shall serve as a warning to would-be enemies not to attack them, and they have usually obtained this in the form of conspicuous or brilliant colouration, very distinct from the protective tints of the defenceless animals allied to them" (*Darwinism*, page 232).

For examples of so-called warningly coloured animals, we may refer the reader to Wallace's *Darwinism*, Poulton's *Essays on Evolution*, or Beddard's *Animal Colouration*. An instance familiar to all is our English ladybird. "Ladybirds," says Wallace, "are another uneatable group, and their conspicuous and singularly spotted bodies serve to distinguish them at a glance from all other beetles."

In order to establish the theory of warning colouration, it is necessary to prove that all, or the great majority of conspicuously-coloured organisms, are either unpalatable or mimic unpalatable forms. If this be so, we are able to understand that the possession of gaudy colouring may be of advantage to the individual. But even if this be satisfactorily proved, we

must bear in mind that it does not necessarily follow that these warning colours can be accounted for on the theory of natural selection. For, in order to explain the existence of any organ by the action of natural selection, we must be able to demonstrate the utility, not only of the perfected organ, but of the organ at its very beginning, and at each subsequent stage of development. This, as we shall show, is precisely what the Neo-Darwinians are unable to do. We shall have no difficulty in proving that it would be more advantageous even to a highly nauseous creature to have remained inconspicuously coloured rather than to have gradually become more and more conspicuous.

In the first place, let us briefly examine the evidence on which rests the assertion that all gaudily-coloured insects, etc., are unpalatable, or possess stings, or mimic forms which are thus armed.

In England wasps, bees, and ladybirds are familiar examples of conspicuous insects.

The banded black and yellow pattern of the common wasp and the humble bee are regarded as advertisements or danger signals of the powerful sting.

The red-coat with its black spots is similarly believed to be a warning that the ladybird is not fit to be eaten.

Caterpillars are usually coloured grey or brown,

so as to be inconspicuous; but numerous exceptions occur which are brightly coloured, and of these individuals many have been experimentally proved to be objectionable as food to most insect-eating animals, being either protected by an unpleasant taste, or covered with hairs or spines.

Familiar cases are those of the abundant and conspicuous black and yellow mottled caterpillars of the European Buff-tip Moth (*Pygæra bucephala*), which are much disliked by birds; and the gaily-coloured Vapourer Moth caterpillar (*Orgyia antiqua*), with its conspicuous tufts of hair. Readers will remember that a few years back these caterpillars were a perfect plague in London, in spite of the abundance of sparrows, which feed freely on smooth green and brown caterpillars.

Oft-cited examples of warning colouration, are the three great groups of mainly tropical butterflies—the *Heliconidæ* of America, the *Acræidæ* of Africa, and the *Danainæ* found all over the world. In all of these the sexes are alike. They are, every one, strikingly coloured, displaying patterns of black and red, chestnut, yellow, or white. In most butterflies the lower surface of the wings is of a quiet hue, in order to render the organism inconspicuous when at rest, but in these warningly coloured groups the under surface of the wings is as gaudy as the

upper surface. Their flight is slow. They are tough, and exhale a characteristic odour.

Belt showed that, in Nicaragua, birds, dragon-flies, and lizards seem to avoid the Heliconine butterflies, as the wings of these last are not found lying about in places where insectivorous creatures feed, whereas wings of the edible forms are to be found. Moreover, a Capuchin monkey, kept by Belt, always refused to eat Heliconine butterflies.

Finn investigated the palatability of a number of Indian insects. He found that most of the birds with which he experimented objected to the Danaine butterflies; but they disliked still more intensely two butterflies belonging to groups not universally protected—a swallow-tail (*Papilio aristolochiæ*) and a white (*Delias eucharis*).

Finn further experimented with the tree-shrew or Tupaia (*Tupaia ellioti*), which feeds largely on insects. He found that this creature refused most emphatically all these warningly-coloured butterflies. It would under no circumstances eat the *Danainæ*, whereas the birds would do so if no more palatable insects were offered to them at the time.

Colonel A. Alcock found that a tame Himalayan bear indignantly refused to eat a locust (*Aularches militaris*) gaily coloured with black, red, and yellow, and exhaling an unpleasant-

smelling froth; but this bear readily devoured ordinary brown or green species.

Among cold-blooded vertebrates the common European salamander, with its bright black and yellow markings, is a striking example of warning colouration; its skin exudes, on pressure, a very poisonous secretion.

Colonel A. Alcock has described a small siluroid sea-fish, brightly banded with black and yellow, and armed with poison spines.

A well-known Indian poisonous snake, the banded Krait (*Bungarus cœruleus*), is conspicuously barred with wide bands of black and yellow; and in South America there occur numerous species of coral snakes, in which red is added to these conspicuous colours.

The only known poisonous lizard—the Heloderm of Mexico—is conspicuously blotched with black and salmon-colour.

Among birds, no instances of warning colouration have been recorded, though Professor Poulton has suggested that possibly the striking and contrasted tints of many tropical species may be due to this cause. The suggestion is an ingenious one, but is at present totally unsupported by evidence.

The skunks are often cited as an excellent example of warning colouration among mammals. Skunks are most conspicuously arrayed in black and white—the latter above, not below, as is

usual—and have bushy tails, which they carry erect. Although less powerful and ferocious than other members of the weasel family, to which they belong, skunks are notoriously protected by their abundant secretion of a very fetid liquid.

For further examples of warning colouration we would refer the reader to Beddard's illuminating book, entitled *Animal Colouration.*

It should be noticed that in all the cases which we have cited the colouration is not only conspicuous, but is found in both sexes, whereas in many undefended animals the male may be just as strikingly coloured, but the female is not.

We may take it as proved that there is a very general relation between gaudy colouring and inedibility, or rather unpalatability, among insects. It may safely be said that any species of insect which lives, either as an adult or as a larva, in the open will perish in the struggle for existence if, being conspicuously coloured, it is neither inedible nor armed with a weapon such as sting, nor provided with a thick cuticle, nor resembles in appearance some creature which is protected.

But from this it is not legitimate to conclude, as Neo-Darwinians do, that these brilliant colours have been slowly brought into being by natural selection.

Why should any creature, having by the "luck" of variation and heredity acquired some

quality—be it strength, pugnacity, sting, or unpleasant taste—which renders it comparatively immune from persecution, proceed to advertise the fact by assuming a gaudy or striking colour? It would surely be better for such an organism to remain inconspicuous. By becoming showy it is visible to every young bird who, not having yet learned that the creature in question is unfit for food, seizes and perhaps kills it. It is true that the young bird vows that never again will it touch another such organism. But of what avail to the dying example of warning colouration is the resolution of the young bird? Moreover, the organism in question, by being conspicuous, also advertises itself to those few enemies which will eat it. There are always, as Professor Poulton justly remarks, animals which are enterprising enough to take advantage of prey which has at least the advantage of being easily seen and caught.

It is possible to cite cases where animals, notwithstanding the fact that they possess natural defences, become the prey of others in some exceptional cases.

The salamander can be eaten with comparative impunity by the toad, a creature very likely to meet with it.

The toad itself may be eaten; Finn saw the Indian toad (*Bufo melanostictus*) eat another of its own kind. He further observed that the

Indian water-snake (*Tropidonotus piscator*) and the "Crow pheasant" cuckoo (*Centropus sinensis*), in the free state, and the Indian Roller (*Coracias indica*) and the Pied Hornbill (*Anthracoceros*), in captivity, eat the warningly-coloured toad. On the other hand, a captive Racket-tailed drongo rejected toads when offered to it. The common cuckoo is well known to feed on hairy and "warningly-coloured" caterpillars.

Finn has also seen the glossy cuckoo in Zanzibar devouring black-and-yellow caterpillars. Moreover, in America crows are found to select deliberately highly polished and strongly flavoured beetles. Yet again, wasps are preyed upon by bee-eaters, and also eaten by our common toad. In India, Finn found, by many experiments, that the common garden lizard, or "bloodsucker" (*Calotes versicolor*), would eat, both in captivity and in freedom, all "warningly-coloured" butterflies, not only the *Danainæ*, but even *Delias eucharis* and the pre-eminently nauseous *Papilio aristolochiæ*. That this reptile is a great enemy to butterflies is rendered probable by the frequent occurrence of specimens of these insects with its semicircular bites in their wings.

Further, Finn found that bulbuls, the commonest garden birds in India, ate the *Danainæ* readily in captivity, even when other butterflies could be had, which was not the case with most

other birds. Bulbuls did, however, usually refuse the *Delias* and *Papilio* mentioned above.

The Skunk is preyed upon in America by the Eagle-owl (*Bubo virginianus*) and the Puma.

Thus, animals provided with natural defences are not immune from attack.

Hence natural selection cannot have encouraged the survival of individuals which displayed a conspicuous colour, for the sake of the "warning."

We must not forget that many creatures armed with powerful weapons possess the unobtrusive drab, brown, or green colouration which is associated with concealment from foes.

There can be little doubt that, but for the fact that the hive-bee can inflict a sting more severe than that of the wasp, this useful insect would have been cited as a case of a protectively coloured creature. Notwithstanding its sober brown colouring, the hive-bee is recognised and avoided.

Professor Poulton records that the dull inconspicuous caterpillar of the moth (*Mœnia typica*) is rejected by reptiles. It must be admitted, however, that these cases among insects are very rare.

The smooth newt (*Molge vulgaris*), a relation of the salamander, is protected by a poisonous skin; nevertheless the creature has a dark brown back and spends most of its time on land. Its

black-spotted, yellow under-surface may have some protective value in the water. Neither the pike nor the common European water-tortoise will eat this newt.

Toads are nearly all very inconspicuous; nevertheless they are well protected by the acrid secretion from the skin glands; moreover, they are both recognised and avoided by those predacious creatures to whom they are distasteful. Hawks, although as a rule plainly coloured, are certainly recognised by all other birds. It would seem, therefore, that "warning colours," like the similar striking hues of many domestic animals, are incidental attributes. It has been possible for their owners to develop them, because for the most part let alone.

Eisig, long ago, pointed out that the brightly coloured pigment in the skin of these warningly coloured insects is in certain cases of an excretory nature. Therefore the inference which should be drawn is, as Beddard points out on page 173 of his *Animal Colouration*, "*that the brilliant colours* (i.e. *the abundant secretion of pigment*) *have caused the inedibility of the species, rather than that the inedibility has necessitated the production of bright colours as an advertisement.*" In other words, Neo-Darwinians put the cart before the horse!

In some cases these brilliantly coloured insects may be survivals of an age in which there were



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BOURU FRIAR-BIRD

Like most of the group to which it belongs, this honey-eater (*Tropidorhynchus bouruensis*) is a soberly coloured bird, but is noisy, active, and aggressive.



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BOURU ORIOLE

This "mimicking" oriole (*Oriolus bouruensis*) is of the same tone of colour as its supposed model the Friar-bird of the same island.

no birds. When these came into being and began to prey upon insects, the conspicuously coloured species which were not inedible or very unpalatable would soon become extinct, while those that were inedible would survive as warningly-coloured insects. In other cases it is not improbable that these warningly-coloured creatures have arisen by mutations from more soberly-hued insects. It is conceivable that every now and again a mutation occurs which renders its possessor conspicuous. This will result in the early destruction of these aberrant individuals unless their newly-acquired gaudiness is either correlated with, or the result of, distastefulness.

In the case of warning colouration, the Neo-Darwinians have, as usual, pursued their theory to absurd lengths. Professor Poulton, for example, extends it to sounds and attitudes. "Sound," he writes, on page 324 of *Essays on Evolution*, "may be employed as an Aposematic character, as in the hiss of some snakes and some lizards. Certain poisonous snakes when disturbed produce by an entirely different method a far-reaching sound not unlike the hiss. Thus the rattle-snake (*Crotalus*) of America rapidly vibrates the series of dry, horny, cuticular cells, movably articulated to each other and to the end of the tail. The stage through which the character probably arose is witnessed in

another genus which vibrates its tail among dry leaves, and thus produces a warning sound. The deadly little Indian snake (*Echis carinata*) ('the Kuppa') makes a penetrating swishing sound by writhing the coils of its body one over the other. Special rows of the lateral scales are provided with serrated keels which cause the sound when they are rubbed against each other. Large birds, when attacked, often adopt a threatening attitude, accompanied by an intimidating sound which usually suggests more or less closely the hiss of a serpent, and thus includes an element of mimicry. . . . The cobra warns an intruder chiefly by attitude and by the broadening of its flattened neck, the effect being heightened in some species by the 'spectacles.' In such cases we often witness a combination of cryptic and Aposematic methods, the animal being concealed until disturbed, when it instantly assumes a warning attitude.

"The benefit of such intimidating attitudes is clear: a venomous snake gains far more advantage by terrifying than by killing an animal it cannot eat. By striking, the serpent temporarily loses its poison, and with this a reserve of defence. Furthermore, the poison does not cause immediate death, and the enemy would have time to injure or destroy the snake."

At first sight this reasoning may seem very convincing. But consider for a moment the

process by which the hiss originated and gradually increased by natural selection. We must suppose that the rattle-snake was formerly incapable of making any sound. One day a variety appeared in which the skin was slightly hardened, so that when the creature moved its body rapidly there issued a slight sound. This must have caused an enemy to refrain from attack; it thus lived to transmit this peculiarity to its offspring, and those which made more noise than their ancestors escaped, while those that made less succumbed to their enemies. For ourselves, we find it quite impossible to believe that the rattle was thus gradually evolved by means of natural selection. Indeed, we are inclined to think that neither the hiss of the cobra nor its "intimidating attitude" has any terrifying effect on its adversary. In the case of the cobra we are able to cite positive evidence that dogs and cattle show no alarm at the attitude.

"Dogs," writes D. Dewar of this display, "regard it as a huge joke. Of this I have satisfied myself again and again, for when out coursing at Muttra we frequently came across cobras, which the dogs used invariably to chase, and we sometimes had great difficulty in keeping the dogs off, since they seemed to be unaware that the creature was venomous."

Colonel Cunningham writes, on page 347 of *Some Indian Friends and Acquaintances*: "Sport-

ing dogs are very apt to come to grief where cobras abound, as there is something very alluring to them in the sight of a large snake when it sits up nodding and snarling; and it is often difficult to come up in time to prevent the occurrence of irreparable mischief."

Colonel Cunningham also states that many ruminants have a great animosity to snakes, and are prone to attack any that they may come across.

We may therefore well be sceptical as to the value of intimidating attitudes to those creatures which are in the habit of striking them.

Mimicry

In a work of this kind it is neither possible nor necessary to consider in great detail the mass of evidence which has been advanced in favour of the theory of mimetic resemblance.

Chapters vii. and viii. of Professor Poulton's *Essays on Evolution* contain an up-to-date statement of the facts in favour of the theory. Professor Poulton believes that in all cases mimetic resemblance is the result of the action of natural selection.

He admits that there is no direct evidence in its favour, but asserts that "the facts of the cosmos, so far as we know them, are consistent with the theory, and none of them inconsistent with it" (page 271).

Theory of Protective Mimicry

We are not at all sure that no facts are against the theory of protective mimicry. We shall presently set forth some which to us seem, if not actually inconsistent with the theory, at least to point to the conclusion that the phenomenon may be explained otherwise than as a product of natural selection.

Let us first briefly state the case for the theory of protective mimicry.

1. It is asserted that the mimicking species and that which is mimicked are often not nearly related. For example, the unpalatable larva of the Cinnabar Moth (*Euchelia jacobaeæ*) is said to mimic a wasp, because it has black and yellow rings round its body.

"The conclusion which emerges most clearly," writes Poulton (p. 232), "is the entire independence of zoological affinity exhibited by these resemblances." This is supposed to be proof that Darwin was wrong when he asserted that the original likeness was due to affinity. Says Poulton: "The preservation of an original likeness due to affinity undoubtedly explains certain cases of mimicry, but we cannot appeal to this principle in the most remarkable instances."

2. It is asserted that species which are mimicked are invariably either armed with a sting, well defended, or unpalatable, so that it is against the interest of insectivorous creatures to attack them. It is further asserted that the

species imitated are "even more unpalatable than the generality of their order."

3. It is pointed out that the most distasteful groups of butterflies—the *Danaidæ*, the *Acræinæ*, the *Ithomiinæ*, and the *Heliconinæ*—consist of large numbers of species which closely resemble one another. This is said to be due to Müllerian mimicry. Mayer states that in South America there are 450 species of inedible *Ithomiinæ* which display only 15 distinct colours, while the 200 species of *Papilio*, which are edible, exhibit 36 distinct colours. Nevertheless, he says, there is no lack of individual variability among the former hence their conservatism as regards colour cannot be attributed to their having but little tendency to vary.

4. It is asserted that although in many cases the mimetic resemblances extend to the minutest detail, nevertheless they are not accompanied by any changes in the mimetic species except such as assist in the production or strengthening of a superficial likeness.

Pictures illustrating such cases of mimicry are figured on pp. 241, 247, and 251 of Wallace's *Darwinism* (1890 edition).

5. It is stated that mimetic resemblance is not confined to colour, but extends to pattern, form, attitude, and movement; that deep-seated organs are affected when the superficial resemblance is intensified, but not otherwise. Poulton cites

Clytus arietis, the "wasp-beetle," as an example of this.

6. It is asserted that mimetic resemblances are produced in the most diverse ways; that the modes whereby the similarity in appearance is brought about are varied, but the result is uniform.

"A lepidopterous insect," writes Poulton (p. 251), "requires above all to gain transparent wings, and this, in the most striking cases that have been studied, is produced by the loose attachment of the scales, so that they easily and rapidly fall off and leave the wing bare except for a marginal line and along the veins (*Hemaris*, *Trochilium*)."

7. It is alleged that the imitator and imitated are always found in the same locality. If they did not do so no advantage would be derived from the resemblance. It is further alleged that where the mimicking species is edible it is invariably less abundant where it occurs than the species it imitates.

8. It is pointed out that it sometimes happens that where in the mimic the sexes differ in appearance, the male copies one species, the female quite a different one. This is said to be because the deception would be liable to be detected if the mimicking species became common relatively to that which is imitated. "We therefore find that two or more models are mimicked

by the same species" (*Essays on Evolution*, p. 372).

Occasionally the female mimics two other species, *i.e.* she occurs in two forms, each like a different species.

It sometimes happens that the female alone mimics. This is said by Wallace to be due to her greater need of protection. When she is laden with eggs her flight is slow, and therefore she requires a special degree of protection.

9. It is said that in some species we find a non-mimetic ancestor preserved on islands where the struggle for existence is less severe, while on the adjacent continent mimicry has been developed.

10. It is alleged that in the cases where moths resemble butterflies the former are either as diurnal as the butterflies or are species which "readily fly by day when disturbed."

11. It is asserted that some seasonally dimorphic forms are examples of mimicry only in one state, in the form that comes into being at the time when the struggle for existence is most severe; that is to say, in the dry season, in Africa, when insect life is far less abundant than in the rainy season.

In other cases the mimicry of the dry-weather form is said to be far more perfect.

Instances of this phenomenon are set forth in Professor Poulton's *Essays on Evolution.*

It will be observed that we have quoted very largely from Professor Poulton's work. Our reason for so doing is that he appears to be the most prominent advocate of the theory of protective mimicry, and his work, which was published in 1908, may be taken as the latest Neo-Darwinian pronouncement on the subject.

Hence if we can show, as we believe we can, that his arguments are not sound, we may take it that we have demonstrated that the theory in its present form is untenable.

It is worthy of notice that Professor Poulton sets forth three other suggestions which have been proposed as substitutes for natural selection as an explanation of the phenomena of mimicry.

The first is the theory of External Causes, namely, that the resemblance is due to some external cause, such as food or climate.

The second is the theory of Internal Causes, which states that mimetic resemblance is due to internal developmental causes.

The third is the suggestion that sexual selection has caused the origin of these resemblances.

He then proceeds to demolish these to his own satisfaction, and adds triumphantly, "The conclusion appears inevitable that under no theory, except natural selection, do the various resemblances of animals to their organic and

inorganic environments fall together into a natural arrangement and receive a common explanation" (p. 228).

To reasoning of this description there is an obvious reply. Even if it be granted that the alternatives to the theory of natural selection as set forth by Professor Poulton are untenable, it does not follow that natural selection affords an adequate explanation. If A, B, C and D are charged with theft and the prosecutor proves that neither A nor B nor C committed the theft, this will not suffice to secure the conviction of D. It is quite possible that a fifth person, E, may be the culprit.

Much of the popularity of the theory of natural selection is due to the fact that biologists have not yet been able to discover a substitute for it.

It seems to us that the proper method of making progress in science is not to bolster up natural selection by ingenious speculations, but to look around for other hitherto undiscovered causes.

Objections to the Theory that the so-called Cases of Mimicry owe their Origin to Natural Selection

It is obvious that for one creature to resemble another can be of little or no benefit to either until the resemblance is tolerably close. It is,



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KING-CROW OR DRONGO

This very conspicuous black bird (*Dicrurus ater*), ranging from Africa to China, is a striking feature of the landscape wherever it occurs.



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DRONGO-CUCKOO

The fork of the tail in this bird is unique among cuckoos, but is nevertheless much less developed than in the supposed model, and may be an adaptation for evolution in flight, as such tails usually appear to be.

therefore, insufficient to prove the utility of the perfected resemblance. We may readily grant this and yet maintain that the origin of the resemblance cannot be due to the action of natural selection.

The Drongo-cuckoo (*Surniculus lugubris*) displays so great a likeness to the King Crow (*Dicrurus ater*) that it is frequently held up by Neo-Darwinians as an excellent example of mimicry among birds. But D. Dewar writes, on page 204 of *Birds of the Plains*: "I do not pretend to know the colour of the last common ancestor of all the cuckoos, but I do not believe that the colour was black. What then caused *Surniculus lugubris* to become black and assume a king-crow-like tail?

"A black feather or two, even if coupled with some lengthening of the tail, would in no way assist the cuckoo in placing its egg in the drongo's nest. Suppose an ass were to borrow the caudal appendage of the king of the forest, pin it on behind him, and then advance among his fellows with loud brays, would any donkey of average intelligence be misled by the feeble attempt at disguise? I think not. Much less would a king-crow be deceived by a few black feathers in the plumage of a cuckoo. I do not believe that natural selection has any direct connection with the nigritude of the drongo-cuckoo."

Darwin was fully alive to this difficulty when

he wrote: "As some writers have felt much difficulty in understanding how the first step in the process of mimicry could have been effected through natural selection, it may be well to remark that the process probably commenced long ago between forms not widely dissimilar in colour" (*Descent of Man*, 10th Ed., p. 324). Such a statement is of course quite inconsistent with the Neo-Darwinian position. "The conclusion which emerges most clearly," writes Poulton (*Essays on Evolution*, p. 232), "is the entire independence of zoological affinity exhibited by these resemblances; and one of the rare cases in which Darwin's insight into a biological problem did not lead him right was when he suggested that a former closer relationship may help us to a general understanding of the origin of mimicry. The preservation of an original likeness due to affinity undoubtedly explains certain cases of mimicry, but we cannot appeal to this principle in the most remarkable instances."

It is unnecessary to labour this point. It is surely evident to everyone with average intelligence that, until the resemblance between two forms has advanced a considerable way, the likeness cannot be of utility to either, or at any rate of sufficient utility to give its possessor a survival advantage in the struggle for existence. Until it reaches this stage, natural selection cannot

operate on it. It is therefore absurd to look upon natural selection as the direct cause of the origin of the likeness. When once a certain degree of resemblance has risen, it is quite likely that in some cases natural selection has strengthened the likeness.

The second great objection to the Neo-Darwinian explanation of the phenomenon known as mimicry is that in many cases the resemblance is unnecessarily exact. Even as we saw how the Kallimas, or dead-leaf butterflies, carried their resemblance to dead leaves to such an extent as to make it appear probable that factors other than natural selection have had a share in its production, so do we see in certain cases of mimetic resemblance an unnecessarily faithful likeness.

The common Hawk Cuckoo of India (*Hierococcyx varius*) furnishes an example of this: "The brain-fever bird," writes Finn, on page 58 of *Ornithological and Other Oddities*, "is the most wonderful feather copy of the Indian Sparrow-hawk or Shikra (*Astur badius*). All the markings in the hawk are reproduced in the cuckoo, which is also of about the same size, and of similar proportions in the matter of tail and wing; and both hawk and cuckoo having a first plumage quite different from the one they assume when adult, the resemblance extends to that too. Moreover, their flight is so much the same that

unless one is near enough to see the beak, or can watch the bird settle and note the difference between the horizontal pose of the cuckoo and the erect bearing of the hawk, it is impossible to tell them apart on a casual view." Moreover, the tail of the cuckoo sometimes hangs down vertically, thus intensifying the likeness to the hawk.

It is quite possible that the brain-fever bird derives some benefit from the resemblance; indeed, it has been seen to alarm small birds, even as the hawk-like common cuckoo frightens its dupes, but, as D. Dewar pointed out, on page 105 of vol. 57 of the *Journal of the Society of Arts*, "this is not sufficient to explain a likeness which is so faithful as to extend to the marking of each individual feather. When a babbler espies a hawk-like bird, it does not wait to inspect each feather before fleeing in terror; hence all that is necessary to the cuckoo is that it should bear a general resemblance to the shikra. The fact that the likeness extends to minute details in feather marking, points to the fact that in each case identical causes have operated to produce this type of plumage." This conclusion is still further strengthened by the fact that the likeness extends to the immature plumage, that is to say, exists at a time when it cannot assist the cuckoo in its parasitical work.

Poulton meets this objection as follows:



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SHIKRA HAWK

The upper surface of the tail, not shown in this drawing, exactly corresponds with that of the cuckoo "mimic."



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HAWK-CUCKOO

This species (*Hierococcyx varius*) is commonly known in India as the "Brain-fever bird."

"All such criticism is founded on our imperfect knowledge of the struggle for existence. The impressions and judgments of man are immensely influenced by the 'corroborative detail,' giving 'artistic verisimilitude to a bold and unconvincing narrative.' Indeed, the laughter which is invariably raised by this passage from *The Mikado* is, I have always thought, not only or chiefly due to the humour of the application, but to the way in which a great and familiar truth breaks in upon the listener with all the pleasing surprise which belongs to epigram. Birds, the chief enemies of insects, are known to have powers of sight far superior to those of man, and, from our experience of them in captivity, it may be safely asserted that their attention is attracted by excessively minute detail. Until our knowledge of the struggle for life is far more extensive than at present, the argument founded on Hypertely may be left to contend with another argument often employed against the explanation of cryptic and mimetic resemblance by natural selection. Hypertely assumes that there are unnecessary details in the resemblance, that the resemblance is perfect beyond the requirements of the insect; the second argument maintains that birds are so supremely sharp-sighted that no resemblance, however perfect, is of any avail against them. In the meantime the majority of naturalists will probably reject both extremes, and believe that

the enemies are certainly sharp-sighted and successful in pursuit, but that perfection in detail makes their task a harder one, and gives to the individuals possessing it in a higher degree than others, increased chances of escape, and of becoming the parents of future generations." (*Essays on Evolution*, p. 302.)

This long quotation requires careful consideration, since to us it appears to be typical of the kind of reasoning resorted to by Neo-Darwinians.

Note the reference to our "imperfect knowledge of the struggle for existence." This is almost invariably the last refuge of the Neo-Darwinian when worsted in argument. We fully admit that there is still much to be learned of the nature of the struggle for existence, but such a statement sounds very curious when uttered to those who pin their faith to the theory which sees in the principle of natural selection an explanation of all the phenomena of the organic world. Natural selection, be it remembered, is but a name for the struggle for existence.

"Birds," says Professor Poulton, "are the chief enemies of insects." This may be so. But we greatly doubt whether they are the chief enemies of butterflies and moths, among which the most perfect examples of mimicry are supposed to occur.

We have watched birds closely for some years, but believe that we could almost count on our

fingers the cases in which we have seen a bird chase a butterfly.

Professor Poulton, being aware of this objection, sets forth, on pp. 283-292 of *Essays on Evolution*, the evidence he has gathered in favour of the view that birds are the chief enemies of butterflies and other lepidoptera.

As the result of five years' observation in S. Africa, Mr G. A. K. Marshall was able to record some eight cases of birds capturing butterflies. In three cases the butterfly seized was warningly coloured, or, at any rate, conspicuous! In two of these eight cases the bird failed to capture its quarry!

Says Mr Marshall, "the fact that birds refrain from pursuing butterflies may be due rather to the difficulty in catching them than to any widespread distastefulness on the part of these insects."

During six years' observation in India and Ceylon, Colonel Yerbury records some half dozen cases of birds capturing, or attempting to capture, insects. He writes: "In my opinion an all-sufficient reason for the rarity of the occurrence exists in the fact that in butterflies the edible matter is a minimum, while the inedible wings, etc., are a maximum."

Colonel C. T. Bingham in Burma states that between 1878 and 1891 he on two occasions witnessed the systematic hawking of butterflies

by birds, although he observed on other occasions some isolated cases.

This appears to be the sum total of the evidence adduced by Professor Poulton as regards the capture of butterflies by birds. This seems to us an altogether insufficient foundation upon which to build the theory that the cases of resemblance between unrelated species have been effected by natural selection.

It is, however, to be noted that probably among birds the most dangerous enemies of butterflies are not those that habitually catch insect prey on the wing. Such are experts in the art of fly-catching, and would despise the comparatively meatless butterfly. One often comes across butterflies with an identical notch in each wing, which leaves little room for doubt that those particular butterflies had been snapped at, *while resting*, by a bird. Among birds the chief enemies of butterflies and moths are probably to be found in those that hunt for their food in bushes and trees.

Thus, what we do know of the nature of the struggle for existence offers but poor support to the Neo-Darwinian explanations of the cases of so-called mimicry in nature.

Professor Poulton's idea of pitting the argument of hypertely against that of the alleged supreme sharp-sightedness of birds is ingenious, but is not likely to satisfy very many people save

those content to live in a fools' paradise. If birds are supremely sharp-sighted, and pay attention to excessively minute detail, the difficulty of accounting for the *origin* of protective mimicry on the natural selection hypothesis becomes all the greater.

The question whether or not birds are good observers is a most interesting one. Unfortunately, hitherto, but little attention has been paid to the subject. The evidence available seems to point to the fact that birds, like savages, have sharp eyes only for certain objects—that is to say, for the things they are accustomed to look out for. All observers of nature must have noticed how quick a butcher-bird is to catch sight of a tiny insect upon the ground at a distance of some yards from his perch.

On the other hand, it is said that when there is snow upon the ground wood pigeons will approach quite close to a man wearing white clothes and a white hat, provided he keep perfectly still. Finn once witnessed in Calcutta a sparrow pick up a very young toad, obviously by mistake, for it dropped it at once with evident distaste. Birds of prey are supposed to have remarkably good eyesight; yet they can readily be caught by a net stretched out before their quarry. They are not trained to be on the watch for such things as nets, and so do not appear to notice one when erected.

It is thus our belief that the very perfection and detail of some so-called mimetic resemblances are a very serious objection to the theory of protective mimicry as enunciated by Professor Poulton and other Neo-Darwinians.

There is yet a further objection to this theory, one which, in our opinion, is fatal to the hypothesis in its generally accepted form.

A number of cases occur where two species, in no way related, show close resemblance to one another under such circumstances that neither can possibly derive any benefit from the likeness. The theory of protective mimicry is quite unable to explain these cases. This fact leads to a suspicion that, in the instances where the theory does at first sight appear to offer an explanation, the resemblance may also be due to mere coincidence.

We may perhaps call the cases which the theory of mimicry is unable to account for "false mimicry," but in so doing we must bear in mind the possibility that some, at any rate, of the examples of so-called mimicry may, on further investigation, prove to be nothing of the kind.

"False" Mimicry among Mammals

The Cacomistle of Mexico (*Bassaris astuta*), one of the raccoon family, has a grey body and long black-and-white ringed tail, just like the ring-tailed Lemur of Madagascar (*Lemur catta*);

both are arboreal and about the same size, and this lemur's colouration is exceptional in its family.

The banded Duiker-buck of West Africa (*Cephalophus doriae*), has the same very unusual colouration as the thylacine or marsupial wolf of Tasmania, light brown, with bold black bands across the hinder part of the back, and the animals are about the same size.

The dormouse of Europe closely resembles a small American Opossum (*Didelphys murina*), and a larger opossum (*D. crassicaudata*) is very like the Siberian Mink (*Mustela sibirica*).

The Flying Squirrel of North America (*Sciuropterus volucella*) is closely copied by the Flying Phalanger (*Petaurus breviceps*) of Australia.

It will be readily seen that in no one of these cases can the likeness be of utility to either the "model" or the "copy."

False Batesian Mimicry among Birds

There are many instances of this phenomenon among birds. The New Zealand Cuckoo (*Urodynamis tritensis*) shows a far closer resemblance to the American Sparrow-hawk (*Accipiter cooperi*) than to any New Zealand hawk, and in fact closely mimics this quite alien bird.

The stormy petrel, a purely oceanic bird, closely resembles in size, colour, and style of flight the Indian Swift (*Cypselus affinis*), a purely

inland creature; both are sooty black, with a conspicuous white patch on the lower back.

The Pied Babbling Thrush (*Crateropus bicolor*) of Africa is singularly like the Pied Myna (*Grœulipica melanoptera*) of Java, both being of about the same size, with white body and black wings and tail quills. This, we may add, is a very unusual colouration among small birds.

The black-headed Oriole (*Oriolus melanocephalus*) of India is very similar in appearance to the common Troupial (*Icterus vulgaris*) of Brazil; indeed, the troupials, a purely American group, are so like the old world orioles in colour that they usurp their name in America.

The little insectivorous Iora (*Ægithina tiphia*) of India strongly resembles in size and colour a Siskin (*Chrysomitris colambiana*) from South America, the males in both being black above and yellow below, while in the females the black is replaced by olive-green.

Another Indian babbler (*Cephalopyrus flammiceps*), yellowish-green, with orange forehead, is closely copied by, or copies, the well-known Brazilian Saffron-finch (*Sycalis flaveola*).

In Fergusson Island, near New Guinea, there is a ground pigeon (*Otidiphaps insularis*) which is black with chestnut wings, like several of the powerful ground cuckoos of the genus *Centropus*, but no species of these cuckoos so coloured appears to inhabit the island.

In Africa there is a tit (*Parus leucopterus*) which has the same very unusual colouration as an East-Indian bulbul (*Micropus melanoleucus*), both being black with a white patch on the wing-coverts. These two birds are about the same size. As showing the purely coincidental character of such resemblances, we may mention that this same rare pattern occurs again in our Black Guillemot (*Uria grylle*) and in the Muscovy Duck (*Cairina moschata*).

We have already quoted Gadow (p. 198) on "false mimicry" among snakes. He also gives, on p. 110 of *Through Southern Mexico*, an example of this phenomenon among amphibia. It is, he writes, "impossible to distinguish certain green tree-frogs of the African genus *Rappia* from a *Hyla*, unless we cut them open. If they lived side by side, which they do not, this close resemblance would be extolled as an example of mimicry."

We should be very greatly surprised if abundant examples of "false mimicry" are not found among insects. We trust that this remark will stimulate some entomologist to pay attention to the subject.

It is the essence of Müllerian mimicry that both model and copy are immune from attack from enemies. Unfortunately for the theory, similar resemblances occur among birds of prey,

where neither party can benefit from the association. This gives rise to what we may perhaps call false Müllerian mimicry. Thus the goshawk and peregrine falcon resemble each other in being brown above and streaked below in immature plumage, and having barred underparts and a grey upper plumage when adult.

Having stated the more important objections to the theory of protective mimicry, it now remains for us to deal specifically with each head of evidence offered in its favour.

1. With regard to the assertion that the model and its copy are often not nearly related, we have shown that among mammals and birds instances of resemblance between widely-separated groups occur under such circumstances that neither party can derive any benefit therefrom.

2. As regards the assertion that species which are mimicked are either well-defended or unpalatable, this certainly does not hold good with regard to some at any rate of the coincidental resemblances among birds which we have pointed out; even if these pairs of similar species lived in the same country it would require considerable ingenuity to say why one should mimic the other.

3. As regards the argument that the inedible species of *Ithomiinæ*, etc., display only fifteen colours, while the less numerous edible *Papilios*

display more than double this number of colours, we may draw attention to the fact that those birds which are most immune from attack are precisely those which display the smallest range as regards colour, *e.g.*, hawks, owls, crows, gulls, storks, and cranes. As we have already submitted, no question of Müllerian association comes in here.

On the other hand, the eminently edible families of game-birds and ducks display great variety of colour, in the males at all events.

4. As regards the statement that although in many cases the mimetic resemblances extend to the minutest detail, they are not accompanied by any structural changes except such as assist in the production of a superficial likeness, we may refer to the case we have already cited of the New Zealand cuckoo, which, though it so closely copies an American hawk, is typically cuculine in structure. Here, of course, there can be no question of advantage to the "mimicking" cuckoo in the resemblances.

5. In answer to the argument that mimetic resemblance extends to form, attitude, and movement, as well as colour, and that deep-seated organs are affected only when the superficial resemblance is thereby intensified, we may draw attention to such cases as the following:—

(*a*) The harmless Indian Snake (*Lycodon aulicus*) is closely similar to the well-known Krait (*Bun-*

garus cœruleus), also Indian ; but the resemblance extends to a structural detail which can hardly have mimetic value—namely, the harmless snake has long, fang-like front teeth, though these are unconnected with poison-glands. Animals which come into contact with the krait and its mimic are hardly likely to inspect their teeth.

(*b*) A considerable number of birds of the shrike group—known as Cuckoo-Shrikes (*Campophaga*)—closely resemble cuckoos in plumage ; but even if they derive any benefit from mimicking birds which are credited with being mimics already, they cannot profit by the fact that the shafts of the rump-feathers in both groups are stiffened ; this being a peculiarity which would not be perceptible until the bird was in the grasp of an aggressor.

(*c*) As a third case of coincidence we may refer to the tubercle in the nostril of the Brain-fever-bird (*Hierococcyx varius*), as a minute detail of hawk-like appearance, though not present in the particular species imitated.

6. The argument that mimetic resemblances are producd in the most diverse ways, but the result is uniform, loses much of its force when we consider the various methods by which short-tailed birds appear to have long caudal appendages.

In the peacock it is the upper tail coverts which are elongated ; in the Stanley Crane

(*Tetrapteryx paradisea*) it is the innermost or tertiary quills of wing; in one of the egrets some of the feathers of the upper back grow to a great length and form a train; in the Bird of Paradise (*Paradisea apoda*) the long flank plumes are commonly mistaken for the tail.

In these cases there can be no question of mimicry.

7. We have shown that the idea that imitator and imitated are always found in the same area is absolutely fallacious. In birds, for example, the most striking resemblances appear to occur between species that dwell far apart.

8. We can cite, as parallel to the case of a mimicking species of which the male copies one model and the female another, the strange similarity between the barred brown plumage of the female blackcock and that of the female eider-duck. The males of these species, although both black and white, differ greatly in appearance; but the male blackcock is admittedly very like the male of another species of sea-duck—the scoter.

9. Against the supposed ancestral non-mimetic forms existing on islands we can pit the "mimetic" orioles in small islands and their non-mimetic cousins on the mainland. In Australia an oriole of what appears to be an ancestral style lives beside, but declines to mimic, a friar bird of a very pronounced type.

10. The case of certain diurnal moths mimicking butterflies appears to be explicable without the aid of the theory of protective mimicry. When two species adopt the same method of obtaining food, it not infrequently happens that a professional likeness springs up between them. Of this the swifts and swallows afford a striking illustration.

11. As a set-off to the cases where the alleged mimicry is confined to certain seasons of the year, we may cite the case of the pheasant-tailed Jaçana (*Hydrophasianus chirurgus*), which in its winter plumage might easily be mistaken, when on the wing, for the paddy bird or Pond Heron (*Ardeola grayii*), both being of like size and having a brown back, long green legs, and white wings. Moreover, they are to be found in the same localities in India. At the breeding season, however, they are absolutely different in plumage.

Yet another argument commonly adduced in favour of the theory of protective mimicry is that local variations of the imitated species are sometimes followed by the imitator; thus the butterfly *Danais chrysippus* shows a white patch on the hind wings in Africa, and this is followed by its mimic.

But the same thing occurs, quite irrationally, so to speak, among birds. The peregrine falcon and hobby of Europe are only winter migrants

to India, where they are replaced as residents by the Shaheen (*Falco peregrinator*) and Indian Hobby (*F. severus*). Both these differ from the migratory forms by being blacker above and chestnut below, instead of cream colour. Thus the resemblance occurs in each race. A similar distinction, as noted by Blyth, exists between the Common Swallow (*Hirundo rustica*) and the Swallow (*H. tytleri*) of Eastern Asia, the latter having the whole ventral surface rufous instead of only the throat. Yet no one will suggest that swallows mimic falcons, or that there is mimicry between the peregrine and hobby. It is obvious that such parallel changes occur independently of mimicry.

The Water-rail (*Rallus aquaticus*) and Baillon's Crake (*Porzana bailloni*) of Europe are distinguished from their allies of Eastern Asia by having the sides of the head plain grey, whereas the Eastern Asiatic forms (*R. indicus* and *P. pusilla*) have a brown streak along each side of the face. Here, again, we have an instance of birds of the same family varying together with geographical distribution.

"Recognition" Colours

One of the prettiest conceits of the Wallaceian school of zoologists is the theory of recognition markings.

"If," writes Wallace, on page 217 of *Darwinism*,

"we consider the habits and life-histories of those animals which are more or less gregarious, comprising a large proportion of the herbivora, some carnivora, and a considerable number of all orders of birds, we shall see that a means of ready recognition of its own kind, at a distance or during rapid motion, in the dusk of twilight or in partial cover, must be of the greatest advantage and often lead to the preservation of life. Animals of this kind will not usually receive a stranger in their midst. While they keep together they are generally safe from attack, but a solitary straggler becomes an easy prey to the enemy; it is therefore of the highest importance that, in such a case, the wanderer should have every facility for discovering its companions with certainty at any distance within the range of vision.

"Some means of easy recognition must be of vital importance to the young and inexperienced of each flock, and it also enables the sexes to recognise their kind and thus avoid the evils of infertile crosses; and I am inclined to believe that its necessity has had a more widespread influence in determining the diversities of animal colouration than any other cause whatever. To it may probably be imputed the singular fact that whereas bilateral symmetry of colouration is very frequently lost among domesticated animals, it almost universally prevails in a state of nature;

for if the two sides of an animal were unlike, and the diversity of colouration among domestic animals occurred in a wild state, easy recognition would be impossible among numerous closely allied forms."

As examples of recognition colouration, Wallace cites, among others, the white upturned tail of the rabbit—a "signal flag of danger," the conspicuous white patch displayed by many antelopes, the white marks on the wing- and tail-feathers of the British species of butcher-birds, the stone-chat, the whin-chat, and the wheat-ear.

Wallace therefore asserts, firstly, that recognition marks not only help herbivorous animals to keep together, but act as a danger signal; the member of a flock which first catches sight of the enemy takes to its heels, displaying its white flag, which is the signal of danger to the other members of the flock. Secondly, that recognition marks prevent the evils of infertile crosses. Thirdly, that the necessity of being able to recognise one another has rigidly preserved bilateral symmetry among animals in a state of nature.

As regards assertion number one, we would point out that where a flock of herbivora is being stalked by a beast of prey, the member of the flock nearest to the enemy—that is to say, the hindmost member—will probably be the first to observe him. As that creature will be more unfavourably situated for escape than the rest of

the herd, it will not be to their advantage to follow the line it has taken. Moreover, being at the rear of the flock, it is not in a good position to take the lead, and its pursuer is likely to see the danger signal before its friends do. It would thus seem that "danger signals," while possibly sometimes of service to their possessors, are on the whole ornaments which might profitably be dispensed with. Natural selection can scarcely be charged with the production of a character of such doubtful utility to the organism.

Moreover, flourishing species of many gregarious animals do not possess any "signal flag of danger," while, on the other hand, a great many solitary species display markings that render them very conspicuous when in motion. Take the case of the famous Indian Paddy Bird (*Ardeola grayii*). This, when at rest, is coloured so as to be very difficult to distinguish from its surroundings, but flight transforms it, for it then displays its milk-white pinions, which would make a perfect danger signal, if only it were not peculiarly solitary in its habits. Its gregarious brethren, the Cattle Egrets (*Bubulcus coromandus*), on the other hand, display no danger signal.

That these recognition marks prevent the intercrossing of allied species and the production of infertile hybrids appears to be pure fiction. As we have already shown, hybrids between allied species are by no means always infertile.

Moreover, species which differ only in colour seem usually to interbreed in those parts where they meet.

"This interbreeding," writes Finn, on page 14 of *Ornithological and Other Oddities*, "occurs where the carrion crow (*Corvus corone*) meets the hooded crow (*Corvus cornix*), where the European and Himalayan goldfinches (*Carduelis carduelis* and *C. caniceps*) encounter each other, and where the blue rollers of India and Burma (*Coracias indicus* and *C. affinis*) come into contact, to say nothing of other cases."

Of these other cases, the Indian bulbuls of the genus *Molpastes* form a very remarkable one. In all places where two of the so-called species meet they appear to interbreed, and so freely do they interbreed that at the points where the allied species run into one another it is not possible to refer the bulbuls to either species. Thus William Jesse writes of the Madras Red-vented Bulbul (*Molpastes hæmorrhous*) (page 487 of *The Ibis* for July 1902): "This bird, although I have given it the above designation, is not the true *M. hæmorrhous*. I have examined numbers of skins and taken nests and eggs time after time, and have come to the conclusion that our type is very constant, and at the same time differs from all the red-vented bulbuls hitherto described. The dimensions tally with those given by Oates for *M. hæmorrhous*, while the black of the crown

terminates rather abruptly on the hind neck, and is not extended along the back, as is the case with *M. intermedius* and *M. bengalensis*. On the other hand, as in the two last species, the ear coverts are chocolate. Furthermore, I may add —although I attach little importance to this— that the eggs of the Lucknow bird which I have seen are, without exception, far smaller than my eggs of genuine *M. intermedius* from the Punjab. My own opinion is that the Lucknow race is the result of a hybridisation between the other three species."

Further, in Bannu, Mr D. Donald saw *M. intermedius* and *M. leucogenys* paired at the same nest. That gentleman could not possibly be mistaken on the point, as the latter species has white cheeks and yellow under tail-coverts, while the cheeks of the former species are dark-coloured and the patch of feathers under the tail is red. Similarly, Whitehead and Magrath, writing of the birds of the Kurram Valley (*Ibis*, January 1909), record that the former shot no fewer than twelve bulbuls, which undoubtedly appear to be hybrids between these two species. As these hybrids differ considerably *inter se*, there seems no room for doubt that they breed with one another and with the parent species.

Wallace's third statement, that if the two sides of animals in a state of nature were alike, easy recognition would be impossible among numerous

closely allied forms, reminds us forcibly of the sad case of the boy whose tailor was his mother. *Humanum est errare:* she made her son one pair of trousers that fastened up behind, so that the poor boy when wearing them never knew whether he was going to or coming home from school! If animals are able to recognise their mates, their bilateral symmetry does not seem necessary to enable them to distinguish their fellows from allied species.

It is, indeed, true that asymmetrically marked animals are very rarely seen in the wild state, while they are the rule rather than the exception among domesticated species. But this appears to be due, not to the necessity of recognition markings in nature, but to the fact that those animals that display a tendency to massed pigment perish in the struggle for existence, since this massing of pigment appears to be correlated with weakness of constitution. In other words, this massing of pigment is an unfavourable variation, which under natural conditions dooms its possessor. In the easier circumstances of domestication, animals which are irregularly pigmented are able to survive, so that, among them, the almost universal tendency to the massing of pigment can be followed without let or hindrance.

It is unnecessary to say more upon this subject. The few facts we have set forth suffice to destroy this particular excrescence on the Darwinian theory.

The Colouring of Flowers and Fruits

Extremely interesting though the subject be, we are unable to consider at length the generally accepted theory that the colour markings and perfumes of wild flowers are the result of the unconscious selection exercised by insects.

While not denying that many flowers profit by their colouring, that these colours may sometimes serve to attract the insects, by means of which cross-fertilisation is effected, we are not prepared to go to the length of admitting that all the colours, etc., displayed by flowers and floral structures are due to the unconscious selection exercised by insects. It is one thing to admit that the colour of its flowers is of direct utility to a plant; it is quite another to assert that the colour in question owes its origin and development to natural selection. Our attitude towards the generally accepted explanation of the colours of flowers is similar to that which we adopt towards the theory of protective mimicry among animals. In certain cases we are prepared to admit that the mimicking organism derives benefit from the likeness; but this, we assert, is no proof that natural selection has originated the likeness.

The theory that flowers have developed their colours in order to attract insects to them, and thus secure cross-fertilisation, is based on the

assumption that cross-fertilisation is advantageous to plants. It is questionable whether this assumption is justified. True it is that numbers of experiments have been performed, which show that, in many cases, flowers which are artificially self-fertilised yield comparatively few seeds. But experiments of this kind do not prove very much.

To place on the stigma pollen from the anthers of the same flower, in case of a plant which for many generations has been cross-fertilised, is to subject the plant in question to a novel experience—an experience which may be compared to transplanting it to another soil. The immediate effect may appear to be unfavourable, although, if the experiment be persisted in, the ultimate results may prove beneficial to the plant.

That this is the case with some flowers that are artificially fertilised is asserted by the Rev. G. Henslow. This observer states, that had Darwin pursued his investigations further, he would probably have modified his views regarding the benefits of self-fertilisation. Darwin's statement that "Nature abhors perpetual self-fertilisation" seems to be as far from the truth as that which declares "Nature abhors a vacuum."

From the mere fact that cross-fertilised flowers yield a greater quantity of seed than they do when self-fertilised, it does not necessarily follow

that cross-fertilisation is advantageous. The amount of seed produced is probably not always a criterion as to the advantages of the crossing to the plant. Some flowers yield most seed when fertilised by the pollen from flowers belonging to a different species!

It is significant that some plants produce cleistogamous flowers, that is to say, flowers which invariably fertilise themselves. Such flowers never open; so that the visits of insects are precluded.

According to Bentham, the Pansy (*Viola tricolor*) is the only British species of *Viola* in which the showy flowers produce seeds. The other species are all propagated by their cleistogamous flowers. The genus *Viola* is an advanced species: it would therefore seem that the production of cleistogamous flowers is an advance on the production of entomophilous flowers. Cleistogamous blossoms are obviously more economical.

In the case of the malvas, epilobias and geraniums, where we see, side by side, races of which the individuals produce insect-fertilised flowers and those that are characterised by self-fertilised flowers, the latter are quite as thriving as the former.

The common groundsel, which, according to Lord Avebury, is "rarely visited by insects," flourishes like the green bay tree, as many

gardeners know to their cost. The same may said of the pimpernels. In this connection it is important to bear in mind that the anemophilous, or wind-fertilised, angiosperms, as, for example, the grasses, are believed to be descendants of insect-fertilised or entomophilous forms.

A weighty objection to the theory that the colours of flowers have been developed because they attract insects has been urged by Mr E. Kay Robinson, namely, that among wild flowers the most highly coloured ones are the least attractive to insects.

"Show me," writes he, on page 222 of *The Country-Side* for March 20, 1909, "the insect-collector who will seek for specimens among the brilliant scarlet poppies. Of what use is the dog rose, with its large discs of pinky-white, to him? On the other hand, does he not find that by far the most attractive flowers are the almost invisible spurge laurel blossoms in February and March, the fuzzy sallow catkins in March and April, the bramble blossom in midsummer, and the ivy's small green flowers in autumn? Of these only the bramble has any pretensions to colour, and if you try, as I have tried, the experiment of picking off every petal from sprays of bramble blossoms you will find that its attraction to moths does not appear diminished.

The fact that insects do visit many conspicuously coloured flowers does not show that the colour attracts them, when the fact is borne in mind that they neglect others which are equally coloured, while the flowers which they particularly haunt are inconspicuous. Conspicuous flowers *which have abundance of nectar* attract insects, of course, but so do inconspicuous flowers which have nectar. If they have no nectar, neither the conspicuous nor the inconspicuous flowers attract insects other than pollen or petal eaters, whose visits are not good for the plant. This shows that the nectar attracts the insects and that the colour of the flowers makes no difference."

In autumn many leaves assume bright and beautiful tints. These are not believed to be in any way useful to the plant. The autumnal hues and shades are regarded, and rightly regarded, as the garb of death and decay. Such colours are the result of the oxidation of the chlorophyll or green colouring matter of the leaves. Why should not the colours of the petals of the flowers, which wither and fade long before the green leaves do, be due to a similar cause? The bright colours of fruits are supposed to have been effected by natural selection in order to attract fruit-eating animals. Surely a hungry animal does not require that its food be brightly coloured in order to find it! We

must remember that during the greater part of the year most animals have no occupation save that of finding their food. Inconspicuously coloured fruits, like those of the ivy, are frequently eaten by birds. The bright colours of some ripening fruits are undoubtedly the colours of decay. Many fungi and seaweeds have bright colours. It is never hinted that these are of any direct utility to their possessor.

Every flower, every plant, every organism must be of some colour.

Many flowering plants produce honey. This is said by some botanists to have been directly caused by natural selection, because the honey attracts insects. Possibly those who take up this attitude are putting the cart before the horse. It is probable that honey, like oxygen, is an ordinary product of the metabolism of the plant, and that the visits of bees and other insects to such plants are the result rather than the cause of the honey being there. Boisier found that some plants, for example, *Potentilla tormentilla* and *Geum urbanum*, gave honey in Norway, but very little near Paris.

He further discovered that by supplying certain plants copiously with water he could induce them to produce more than their normal output of honey.

As is their habit, Neo-Darwinians have pushed their pet theory to absurd lengths in its

application to flowers. They assert that the visits of insects are responsible for not merely the general colour of every flower, but also the various lines, spots, and other markings of flowers. The lines that frequently occur on the petals are supposed to guide the insects to the honey! This particular refinement of Neo-Darwinism, to quote Kay Robinson, "needs little discussion. Insects have very poor sight. You can see this when a bee or a butterfly flies bang against a whitewashed wall; when a wasp pounces upon a black spot on a sunlit floor, mistaking it for a fly; or when a settled dragon-fly will allow you to poke it in the face with the end of a walking-stick, although it will be off like a flash if you raise your arm. There is, therefore, large reason to doubt whether insects can even see the fine lines in the throats of flowers which are supposed to guide them to the nectar. It is rather absurd, too, to suppose that such lines can be needed, since insects come in swarms to inconspicuous and apparently scentless flowers or to 'sugared' tree-trunks in the dark. Where there is nectar, insects which have come to the feast from a distance need no pencilled lines to guide them over the last quarter of an inch of their journey."

Neo-Darwinians further assert that the scents of flowers have been developed by natural selection because they serve to attract insect visitors

to the flowers. In support of this contention it is urged that the most highly scented flowers are not usually the most conspicuous ones, since it is not necessary for a flower to be both highly coloured and strongly scented. Again, those flowers which open at night are usually very highly scented.

Plausible though this view seems, there are weighty objections to it. These are so admirably summarised by Kay Robinson in the issue of *The Country-Side* for March 27, 1909, that we feel we cannot do better than reproduce his words :—

"It is true that many flowers which are strongly scented are visited by insects, but these flowers have abundance of nectar, and the insects come in spite of the scent, and not on account of it. They visit unscented flowers, provided that they have nectar, equally freely; and they do not visit flowers which have scent without nectar.

"Moreover, fruits are more generally scented even than flowers; but what explanation have those, who attribute the scents of flowers to the tastes of insects, for the scents of fruits? Insects which visit fruits are only robbers. Therefore, if we say that plants have scents for the purpose of attracting insects, we accuse all plants which have scented fruits of attempted suicide.

"There are hosts of plants, again, with scented leaves. Here also the insects are only robbers,

and it is quite clear that the scent is not useful in attracting insects. If, therefore, you adopt the insect theory to explain the scents of flowers, you must invent entirely new theories to explain the scents of fruits and leaves."

It is thus evident that the ordinarily accepted explanation of the colours, scents, and markings of flowers is far from satisfactory.

Mr E. Kay Robinson has put forth in recent issues of *The Country-Side* (March 20, 27, and April 3, 1909) quite a new explanation of the phenomena, and one which deserves careful consideration. He maintains that "the real, primary, and original meaning of the colours, markings, nectar and scents of flowers is not to attract insects, but to deter grazing and browsing animals."

"I say," he writes, "that grazing and browsing animals avoid eating conspicuous flowers. I have watched a flock of five hundred sheep pass across a yard-wide strip of close-nibbled turf on the Norfolk coast, grazing as they passed, and the number of open daisy blossoms after they had passed seemed the same as before they came. Every one of five hundred sheep had eaten something from that yard of grass, and not one had eaten any of the hundred and thirty odd daisies.

"Every summer the farm horses are turned into the same old pasture, and as the summer wanes the field always presents the same appear-

ance—the green grass close-grazed, the tall buttercups left standing high.

"Once, leaning over a gate with friends, I pointed out that a flock of sheep grazing in a sainfoin field were nibbling the greenstuff close, but were not eating the flowery stalks, when one sheep near us accidentally pulled up a whole sainfoin plant by the roots and proceeded to munch it upwards. Inch by inch the stem passed into its jaws, and I began to be afraid that it was going to establish an 'exception' to my rule. But, just when the bright cluster of pink sainfoin blossom was within two inches of its teeth, it gave an extra nip, and the flower head fell to the ground, and the sheep resumed its search for greenstuff.

"I do not say that this would always happen —I should be sorry for any theory which depended upon the intelligence of a sheep—but it was a very striking object-lesson to my two companions; and any one who looks around during this summer with an inquiring mind will find plenty of evidence that grazing, browsing, and nibbling animals avoid flowers, and stick to greenstuff when they can get it.

"I do not say that all animals avoid the same flowers. Horses, for instance, may dislike large flowers like roses and conspicuous yellow flowers like buttercups, but they will bite off flat clusters of minute white or pale yellow flowers, such as

yarrow or wild parsnip. These distinctions made by certain kinds of beasts will probably in the future be found to afford valuable evidence as to the regions of origin of our flowers and animals. Such plants as the yarrow and the wild parsnip, for instance, probably did not originate in the home of the wild horse, because they are not protected against it.

"As a general rule, however, there is abundance of evidence that plants with conspicuous flowers gain a large advantage in the struggle for existence, because grazing and browsing animals avoid them; while there is no real evidence at all that conspicuous flowers attract insects."

Kay Robinson extends this explanation to the shape, the scent, and the nectar of flowers. He admits that many flowers are adapted to the visits of insects, but this is, he asserts, but a secondary result. The "real, primary meaning" of the shapes of flowers of curious configuration is, he insists, "a deterrent to grazing or browsing animals."

According to him plants, like the snap-dragon, which have "blossoms in the semblance of a mouth," are avoided by grazing animals, because they mistake such flowers for mouths, and have no wish to be bitten! Orchids, he asserts, "are strongly deterrent to grazing and browsing animals, which are looking for greenstuff, and regard these gaudy, spidery, winged blossoms as

live creatures." "If this is not the truth," he asks, "will any adherent of the theory that we owe the shapes of flowers to insects explain why some of our common British orchids are so like bees, spiders, etc.? Some which have no particular resemblance to any insect still exhibit weird shapes, suggestive to the human mind of living things, such as lizards, etc. The reason why they look like bees, spiders, lizards, and various unclassed creatures is quite simple. Grazing animals are looking for greenstuff, and do not wish to eat living creatures which may bite or sting or taste nasty. Thus the orchids have acquired the power of looking like creatures.

"Every one," he continues, "who is familiar with the blossom of the wild carrot—a flat head of minute, dull-white blossoms — must have noticed how very often the centre blossom in each head is purplish or reddish-black. This makes it very conspicuous in the middle of the flat white flower head. Now what conceivable use can this barren little blackish blossom—scarcely bigger than a pin's head—be to the wild carrot plant if we regard the flat head of white flowers as an attraction to the sight of insects? If, on the other hand, we rightly regard the flat head of white blossoms as an advertisement to grazing animals that it is not wholesome greenstuff, but innutritious blossoms liable to be infested with ants and other stinging insects, we

see at once the great use of this small blackish flower in the middle. It looks like an insect, and possibly in the home of the wild carrot there is some minute blackish insect with a peculiarly villainous smell or taste—or perhaps a potent sting — which grazing animals carefully avoid whenever they can see it. Thus the wild carrot flourishes; though here in Britain—where the wild carrot has established itself now—we may fail at first to see the exact meaning of the trick. I think, however, that, when we understand it, it fits admirably into the theory that the shapes and colours of flowers are primarily useful as deterrents to grazing and browsing animals and not as attractions to insects.

"Thus we see," he concludes, "that the queer shapes of these orchids, which are a great stumbling-block in the way of those who preach that we owe the shapes of flowers to the tastes of insects, become a strong confirmation of my theory that we owe the shapes of flowers to grazing and browsing animals."

Of the nectar of flowers, Kay Robinson writes: "Since this is eagerly sought for by hosts of insects, whose visits are in most cases useful to the flowers, it seems only natural to suppose that we see cause and effect in this connection.

"Here, however, I will outline my theory of the origin of nectar and of flowers in general.

"I think there is no doubt whatever that all the parts of a flower are modified leaves. The original type of flowering plant—I think we may safely assume—had a single stem and produced its seed at the summit, as the crown of its year's endeavour. The flower, before it became what we would recognise as a flower, was a cluster of protecting leaves round the seed-making parts of the plant. To the production of the seed the whole energies of the plant were devoted, and into the cluster of leaves at the top of the stem all the essences of the plant were concentrated. If during the coming spring you handle and examine the leaves at the end of the strong shoots of thorns or fruit bushes, you will find that the surface of the young leaves is quite sticky If you observe browsing animals also, you will discover that—contrary to expectation—they do not like strong-growing, juicy shoots, evidently preferring mature leaves lower down the branch. This shows, I think, that plants have the power of protecting their new shoots by crowding into them the volatile oils and essences which they produce as a protection against animals. Now nectar appears always to be distasteful to grazing and browsing animals; and they also dislike scented flowers. I think, therefore, that it is reasonable to suppose that the nectar and scents which now distinguish so many flowers were first produced as an exudation of concentrated sap

upon the surfaces of the protecting leaves round the seed-making parts of the original flowers. As these leaves became more efficiently protective by assuming colours, shapes, and markings which warned animals of their character, so their apparatus for producing scent and honey became specialised; and at this point the insect appeared upon the scene as a factor in the life's success of the plant."

Such, then, is Kay Robinson's bold and original theory. In some respects it seems far-fetched. The natural inclination is to ask, "Is it possible that cattle can be so stupid, so blind, as to really believe that a snap-dragon is the mouth of an animal, or that an orchid is a spider?"

At present we know so little of animal psychology that we are not yet in a position to give an answer to this question. Horses, we know, are apt to be frightened by the most harmless things, such as a piece of brown paper lying on the road. Mr Robinson's theory should give a stimulus to the study of the mind of animals—a study which, if properly undertaken, will probably throw a flood of light upon some of the problems of evolution. Mr Robinson's theory equally with the ordinarily-accepted hypothesis, utterly fails to explain the first origins of colours, scents, etc. When once a flower has acquired a certain amount of colour, it is easy to understand how that flower may attract insects or repel

grazing animals. But how can the origin of the colour or other characteristic be explained?

We asked Mr Kay Robinson how he would account for the great success in the struggle for existence of some species of grasses on which herbivorous animals feed so largely. He replied, in the issue of *The Country-Side*, dated April 3, 1909:—

"The grass has a manner of growth which defies the grazing animal. Its long, thin leaves are constantly pushing upwards from the ground, and, if they are grazed down one day, they will have pushed up again the next. Moreover, when the outside blade of grass has exhausted its power of growing, there is another blade inside it with many inches still to grow, and another inside that which has scarcely begun to grow, and yet another further in which has not yet seen daylight; and so on. In a state of nature grazing animals are nowhere so numerous on any given patch of ground from day to day as to keep down the grass. If they were, carnivorous animals would stay there to eat the grazing animals, and grow fat and multiply. Thus the grazing herds are scattered and wandering, followed wherever they go by the beasts of prey; and in their absence the grass pushes ahead, so that when the grazing animals return its clump is larger and its roots are stronger, and it is better able to survive attack than before.

"The method of the clovers and trefoils is quite different. When circumstances are favourable and enemies few, they will form large-leaved luxuriant clumps, with fine heads of blossom; but where grazing animals abound they have the power of adapting themselves to altered circumstances. They creep so closely along the ground that the teeth of the grazing animal cannot pick them up between the surrounding grass, and they produce leaves so small and short-stalked that to eat them would be like nibbling the pile off velvet. Any clover or trefoil thus growing in self-defence is accepted as the 'shamrock' of Ireland; and it is certainly a fine emblem for a race which regards itself as surviving in spite of incessant oppression.

"These are the reasons, however, why the grasses and clovers or trefoils continue to enrich old pastures when most of the other plants disappear, with the exception of daisies and buttercups, and the acid sorrels."

We should be glad to hear how Mr Robinson accounts for the conspicuous flowers in the species of "prickly pear" (*Euphorbia*), which is so abundant in India, and which is not browsed upon by animals.

We regret that we are not able to devote more space to this most interesting theory. We can only add that, even if it fail to become widely accepted, it is of great value as showing that it

is possible to offer a plausible explanation of a large number of phenomena, which nine out of ten botanists explain in a very different way.

So satisfied are the majority of naturalists with the "insect theory," that they seem of late years to have paid but little attention to the subject of floral colouration. This affords a striking instance of the pernicious influence which Neo-Darwinism is exercising on the minds of men to-day. It tends to stifle research instead of stimulating it.

We have now dealt with the theory of protective colouration, the theory of warning colouration, the theory of mimicry, and the theory of recognition markings. We have shown that although many organisms undoubtedly derive profit from the fact that they are difficult to see in their natural surroundings or from their resemblance to other organisms, the hypothesis that this inconspicuousness or the mimicry of these animals has been caused by the natural selection of small variations is untenable.

Warning colours, we have shown, although a disadvantage to their possessors, are sometimes seen in nature because they are accompanied by unpalatability. The theory of recognition markings must, we fear, be laid to rest in the burial ground of exploded hypotheses.

The extreme popularity of the existing theories regarding animal colouration and their very

general acceptance are to be attributed, firstly, to their simplicity; secondly, to the fact that they have thrown light on many phenomena which previously had seemed inexplicable; thirdly, that if we assume, as the great majority of biologists do, that evolution has been effected by the accumulation of numerous variations, small in degree and indefinite in direction, we seemed forced either to accept Neo-Darwinism or admit that the whole subject of animal colouration baffles us, in other words, to reject what appears like cosmos and substitute for it chaos.

With a few exceptions, books that deal with the colours of organisms, while emphasising the evidence in favour of the generally-accepted theories, seem almost entirely to ignore the host of facts that do not appear to fit in with them.

This is largely due to the almost unavoidable bias of the human mind when obsessed by a pet theory. There are none so blind as those who will not see. It is also, in part, the consequence of the prevalent neglect of the scientific method of comparison which leads men to theorise on insufficient evidence. This, of course, is a natural result of specialisation in biology. Naturalists are in the habit of confining their study to the habits of the animals of one particular country and then making far-reaching generalisations therefrom.

As an example of the kind of theorising to

which this method leads, we may cite the often-quoted theory which ascribes the green colouring of some arboreal fruit-eating pigeons to adaptation to an existence among tropical foliage, and ignores the fact that in America tree-haunting pigeons are never of this colour, and that it is not by any means universal even among the old-world pigeons.

Similarly, a theory has been advanced (W. P. Pycraft, *Knowledge*, 1904, p. 275) that the white down of some nestling birds, is an adaptation to resisting the heat of the sun in open nests. This is at once negatived by the fact that young owls, usually hatched in shaded places, are also generally white, while young cormorants, living in open nests, are black; yet the allied darters, with the same breeding haunts in some cases, have white young. Lest it should be thought that black has some especial value in a nestling living exposed, we may mention that young petrels, which are born in holes, have black or dark down.

As we have already pointed out, naturalists in too readily accepting the theory that variation is minute in degree and indefinite in direction, have raised quite unnecessary difficulties, even for the selection hypothesis. We have cited certain facts, which seem to show that variations, as a rule, are not indefinite in direction; of these the most striking is furnished by

birds in which the tail feathers are greatly elongated. Were variations indeterminate, we might reasonably expect to find that the elongation occurred in one particular feather or pair of feathers in one species, in another pair in a second species, in a third pair in a third species, and so on. But this is not the case ; no bird has one *single* long feather in its tail, and when two are elongated, as is so commonly the case, these are almost invariably the middle or the outside pair; *e.g.*, in the European bee-eater and pheasant it is the former, in the swallow and blackcock, the latter.

Exceptions are so rare that they may almost be said to prove the rule ; *e.g.*, although most terns have the outer-tail feathers elongated, in some of the Noddy Terns (*Anous, Gygis*) the third pair, in others the fourth pair, of tail feathers are the longest. This must mean one of two things, either that the variation, as regards length in tail feathers, other than middle or outer, does not ordinarily occur, or that it occurs, but is, in some way, inimical to the welfare of the species. The latter hypothesis does not seem probable, as the Noddies are particularly abundant birds where they occur, that is to say, in the tropical seas ; therefore, we can only conclude that that particular variation has not occurred in birds as a whole.

We have adduced abundant evidence to show

that mutations or discontinuous variations occur in nature; and as these afford much more favourable material on which natural selection can act, it is reasonable to suppose that they have played a considerable part in evolution.

When discussing the phenomena of inheritance, we attempted to show that, not improbably, these discontinuous variations are due to some re-arrangement in the constituent parts of the unit characters, or biological molecules, as we have called them.

In this connection we may mention the apparently singular phenomenon of different species in the same natural group, exhibiting either a definite excess or deficiency of plumage on the head. Among cranes, most species are more or less bald; but the Demoiselle (*Anthropoides virgo*) has a fully-feathered head with long side-plumes, while the head of the Stanley Crane (*A. paradisea*) appears to be swollen, so abundantly is it feathered. The crowned cranes, although bare-cheeked, have double crests, the two parts of which have been respectively compared to a pen-wiper and a bunch of toothpicks!

Among the guinea-fowls, several species are crested, while others, as, for example, the domestic one, are bare-headed. Now, on the theory of evolution, by accumulation of minute variations, phenomena such as these are difficult

of explanation; but, on the assumption that a slight rearrangement of the biological atoms in the molecule may produce very diverse results, as we see in the case of chemical molecules, and of seasonally dimorphic butterflies, there is no particular ground for surprise at such a phenomenon.

In this connection we may cite the significant fact, so well known to canary breeders, that two crested birds when mated tend to produce a bald-headed one.

If the colour of any part of an organism be due to the internal arrangement of the constituent parts of the biological molecule from which it is derived, we should expect any rearrangement of the component parts to produce quite a different colour. In other words, we should expect occasionally to see colour-mutations. These are precisely what we do see. Similarly, if the scheme of colouring of an organism be due to a certain grouping of biological molecules, we should expect the same scheme of colouring to occur in organisms which are not nearly related. This, too, we observe in nature.

Many of the phenomena of mimicry, and all the cases which we have cited as pseudo-mimicry, seem to us to be referable to this.

Take, for example, the magpie colouration in birds—that is to say, a scheme of colouring in which the body is white, and head, wings, and

tail black. This occurs in the following birds belonging to the most diverse groups :—

The Magpie.

The Magpie Tanager (*Cissopis leveriana*).

The Magpie Robin (*Copsychus saularis*), cock only ; in the hen the black is replaced by brownish grey.

The Pied Honeyeater (*Entomophila picata*).

The Chaplain Crow (white-bodied form of the hoodie crow).

The New Ireland Swallow Shrike (*Artamus insignis*).

The Magpie Goose (*Anseranas melanoleucus*).

Combinations of this kind, in which the black is replaced by brown or grey, are excessively rare.

On the other hand, we see in several birds the combination in which the white is replaced by yellow :—

The Common Troupial (*Icterus vulgaris*).

The Black-headed Oriole (*Oriolus melano cephalus*).

The Black-and-yellow Grosbeak, male only.

What we may call imperfect magpie colouration, *i.e.* where the head becomes white, occurs in several species of birds. The head of a black species sometimes becomes white as a mutation ; in the domestic Muscovy duck, for example, an individual is sometimes produced having a white head, although the black of the remainder of the plumage remains unchanged.

defend themselves. In this connection it is interesting to notice that in New Zealand all birds, whether introduced or indigenous, are particularly liable to albinism. Owing to the fewness of their enemies these albinistic forms are able to persist.

A variation, or rather a mutation, that frequently occurs among domesticated birds, but which is seen in very few wild species, is that which takes the form of white primary feathers on the wing. This variation must often occur in nature, but it rarely establishes itself, apparently because white feathers do not resist wear so well as coloured ones do.

Black-and-yellow colouration occurs in several widely separated species of birds. The arrangement of the two colours follows to some extent the same rules as the black-and-white combination.

Several birds have a yellow body with black head, wings, and tail, such as—

The Black-headed Oriole (*Oriolus melanocephalus*).

The Black-and-Yellow Grosbeaks (*Pycnorhamphus icteroides, P. affinis*) (cock).

The Common Troupial (*Icterus vulgaris*).

In others the black on the head is nearly or quite suppressed, that on the tail remaining to a greater or less extent; such are—

The Golden Orioles (*Oriolus galbula, O. kundoo*, etc.).

Several species of *Icterus*.



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BRAZILIAN TROUPIAL

This species (*Icterus vulgaris*) is that most frequently seen in captivity; the pattern of colour is found in several other allied forms



By permission of Messrs Hutchinson & Co.

INDIAN BLACK-HEADED ORIOLE

Several other orioles besides this (*O. melanocephalus*) have the black head.

Several fly-catchers of the genus *Piezorhynchus* (males only).

We have said sufficient to show that certain combinations of colours recur in nature in species which are neither nearly related to one another nor subjected to similar environment. For such phenomena it is difficult, if not impossible, to account on the theory that natural selection, acting on minute variations, is responsible for all the varied colouring of the animal kingdom. The facts, however, are in accordance with the supposition that the organism is the result of the growth and development of a number of units or biological molecules which exist in the fertilised egg.

If there be any truth in the supposition, the colouration of every animal must be due to the development of one or more of these molecules. Colouration may be expression of the arrangement of all the molecules in the fertilised egg, or it may be due to the development of a number of molecules whose function is to determine the colouring of an organism, or it may be the result of the development of one such molecule, which perhaps splits up in such a way that a portion attaches itself to each of the other molecules.

But it is idle to speculate on this point. As we have already insisted, the tendency to build

up elaborate theories on very slender foundations is a too frequent failing of zoologists. We desire merely to emphasise the fact that the phenomena of animal colouration almost force us to the conclusion that the colouring of each organism is the result of the development of a number of units.

It may be objected that, if this be the case, the number of the units which contribute to the colour of any organism must be exceedingly large, since we see in nature an almost limitless number of different schemes of colouring. If the colour of each animal be the result of the development of a few units, it might be thought, firstly, that the diversity of schemes of colouration which we observe in nature could not possibly occur; and secondly, that, under such circumstances, the colour pattern of a bird or beast should be of the nature of a mosaic, each colour being sharply defined and separated from every other colour, instead of the colours shading one into the other, as is so frequently the case.

Such objections would be based on a misconception as to the nature of the units which combine to produce the colouration of an organism. *These units show themselves as centres of development of colour*, as points from which the colour or colouring they represent spreads, until it meets and mingles with other patches of colour which are being developed from other centres. The colour produced at one centre may spread

more rapidly than that which forms at another; this, of course, will result in a preponderance in the organism of the colour which is produced at the former centre.

Further, we must bear in mind that the development of each colour-producing unit is largely affected by conditions external to it, as we shall see when dealing with Sexual Dimorphism.

More than one naturalist, who has paid careful attention to the subject of animal colouration, has perceived that through the apparently endless diversity of the colouring of organisms something like order runs.

Over thirty years ago Mr Alfred Tylor called attention to this important fact. That observer, whose views met with the approval of Wallace, was of opinion that colour follows structure, and that in a many-hued animal it changes at points where the function changes.

"If," writes Mr Tylor, "we take highly decorated species—that is, animals marked by alternate dark or light bands or spots, such as the zebra, some deer, or the carnivora, we find, first, that the region of the spinal column is marked by a dark stripe; secondly, that the regions of the appendages, or limbs, are differently marked; thirdly, that the flanks are striped or spotted, along or between the regions of the lines of the ribs; fourthly, that the shoulder and hip regions are marked by curved lines; fifthly,

that the pattern changes, and the direction of the lines, or spots, at the head, neck, and every joint of the limbs; and, lastly, that the tips of the ears, nose, tail, and feet, and the eyes are emphasised in colour."

More recently Mr J. Lewis Bonhote has devoted much attention to this important subject. The results of his researches are summarised on page 185 of vol. xxix. of the *Proceedings of the Linnæan Society*, and on page 258 of the *Proceedings of the Fourth International Ornithological Congress*, 1905. Mr Bonhote states that the presence or absence of colour tends almost invariably to make its appearance, first of all, on certain definite tracts, common to mammals and birds alike, which he calls *pœcilomeres*.

"Pœcilomeres," he writes, "are situated on the following parts, viz., chin, malar stripe, maxillary stripe, a spot above and slightly in front of the eye, a spot below or slightly behind the eye, the ear, crown of the head, occiput, fore-end of sternum, vent, rump, thighs, wrist, shoulders (above and below).

"Now, there is hardly any species of bird on which one or more of these pœcilomeres is not 'picked out' (to use a painter's expression) in some colour different from that of the surrounding parts, and, in fact, most of the so-called recognition or protective markings will be found on these patches.

"On the other hand, among many species the differentiation of colour on the pœcilomeres is not so conspicuous as to attract the eye or to serve in any way for protection or mimicry, *yet we still find them marked by differences of colour so slight that, unless especially looked for, they would never be noticed.*

"Or, again, some species occasionally, but not invariably, show a few white feathers on certain parts of their body, and, when such is the case, it will be found that these white feathers appear on the pœcilomeres. . . . There is hardly a species in which examples of these pœcilomeres may not be found. . . . The Kingfisher (*Alcedo ispida*) shows the various head pœcilomeres very clearly, and as examples of inconspicuous differences on these tracts, the rump of the hen sparrow (*Passer domesticus*) and hen chaffinch (*Fringilla cœlebs*), the malar stripe and dark ear-patch of the hen Yellow Bunting (*Emberiza citrinella*), and the dark ante-orbital patch of the Barn Owl (*Strix flammea*) are familiar examples. And, lastly, as an instance of the class where a few white feathers frequently, but not invariably, appear, the young of the cuckoo (*Cuculus canorus*) forms a good example.

"These spots may, however, appear in a transitory manner, as, for instance, where a change of plumage (not necessarily moult) is occcurring."

As an instance of this, Bonhote cites the case

of a young male Shoveler (*Spatula clypeata*), "in which the metallic colour on the head first showed itself on the post-orbital and auricular pœcilomeres, gradually meeting and joining up across the head with the crown and occipital pœcilomeres, and then finally spreading forwards. And it may be well to note that the joining up of the auricular and post-orbital pœcilomeres formed a metallic patch similar in size and position to that found in the male Teal (*Querquedula crecca*), and, further, in the last stage, when the whole head, except the portion round the beak, was metallic, the markings are similar to those found permanently in the hen Scaup (*Fuligula marila*).

Now, these resemblances taking place in the normal pure-bred wild shoveler, the question of reversion does not come in, and no one would suppose these resemblances due to anything more than transitional variation, and it is the object of this portion of the paper to show that variation in colour follows along definite lines."

Mr Bonhote continues: "As a further illustration of how widely spread these lines are throughout the mammalian and avian kingdoms, we may note the assumption of the brown head in the case of the Black-headed Gull (*Larus ridibundus*), which invariably follows each year on lines similar to those related in the case of the shoveler, and . . . the method by which, on the approach of winter, the stoat assumes his

white dress, is (although the change is from brown to white) again conducted along precisely similar lines." Mr Bonhote argues with great force that, as the process occurs in two animals so widely separated, the fundamental cause must be a deep-seated one. There can be no doubt that these pœcilomeres of Bonhote are connected with our biological molecules. Each of these pœcilomeres is the result of the development of one of these unit characters; each is to be regarded as the centre of activity, the sphere of influence of a biological molecule, or the portion of one, which controls the colouring of a definite region of the organism. In the case of creatures which display the same colour throughout, these molecules all give rise to the same kind of colouring; in the case of animals which display a variety of colours and markings the various molecules give origin to various colours. But we must bear in mind that the final colour to which each colour-producing molecule gives rise depends to some extent on circumstances other than the constitution of the molecule. Thus it is that the young in most organisms differ in colour and marking from the adults. On this also depends the phenomena of seasonal and sexual dimorphism. The same colour-producing molecule may give rise to one colour under one set of conditions and to a totally different colour under another set of conditions.

It is a significant fact that under abnormal conditions the feathers of birds tend to disappear precisely on those spots where the pœcilomeres of Bonhote occur.

Thus in a sickly cage bird the feathers frequently show a tendency to fall off on the following spots: crown of head, lores, jaws, head generally, rump, vent and thighs.

Many wild birds—as, for example, the cranes —display patches of naked skin on the head, and these are usually situated on pœcilomeres. Similarly, natural excessive developments of plumage tend to occur on the pœcilomeres, or, rather, the spots characterised by pœcilomeres—for example, the train of the peacock. Loral plumage, it is true, is seldom long, but is often of a peculiar nature.

Colour mutations tend to occur on the pœcilomeres. Thus it is that these pœcilomeres often form the distinctive characters and markings of allied species. This is precisely what we should expect if the pœcilomeres correspond to biological molecules and mutations are the result of the rearrangement of the constituent parts of these molecules.

Still more significant is the fact that the colour-markings in hybrids tend to follow pœcilomeres.

Bonhote has performed a large number of experiments in hybridising ducks. Some of his hybrids were produced from three pure ancestors,

as, for example, the pintail, the spotbill, and the mallard; others from two ancestors. Some of these hybrids were crossed with other hybrids, and others with the parent forms, hence Bonhote secured a number of hybrids, each of which had a distinctive appearance; but *all* the variations appearing among the hybrids were found to start on one or more of the pœcilomeres.

Certain of the hybrids showed a resemblance to one or other of the parent species, others were unlike either parent, and resembled either no known species or species other than their parents.

When a hybrid shows a resemblance to a species other than that to which either parent belongs, it is said to exhibit the phenomenon of atavism or reversion,—the individual is supposed to have been "thrown back" to an ancestral form.

The true explanation of the phenomenon would seem to be that, as the result of the crossing, biological molecules in the fertilised egg have been formed which, on development, give rise to combinations of colour like those seen in other species.

Thus the phenomena of "mimicry" and "reversion" are, we believe, due to the fact that in the fertilised egg of both the pattern and its copy a similar arrangement of biological molecules obtains. If we regard the sexual act as resembling in many respects a chemical synthesis, the phenomenon need not surprise us.

To sum up, the observed facts of animal colouration seem to indicate that there are in each organism some twelve or thirteen centres of colouring, which we suggest may correspond with portions of the fertilised egg. From each of these centres the colour develops and spreads, so that every part of the organism is eventually coloured. These centres of colouring are not altogether independent of one another. Sometimes they all give rise to the same hue, in which case we have a uniformly-coloured organism, such as the raven. More often from some one colour develops, and from others another colour; if these two colours happen to be black and white, the result is a pied organism, which displays a definite pattern due to the correlation of the various colour-producing biological molecules.

Thus it occasionally happens that two widely different organisms exhibit very similar markings, and therefore resemble one another. When this resemblance is believed to be of advantage to one or other of the similarly-coloured species, naturalists call it mimicry, and assert that the likeness is due to the action of natural selection; but where neither organism can profit by the resemblance, zoologists make no attempt to explain it. What we suggest is that the colouration of an animal depends upon the structure, or, at any rate, the nature, of the parts of the egg which produce these centres of colour. But this

is not by any means the only cause that determines the colouration of the organism. If it were, young creatures in their first plumage would invariably resemble the parents, the two sexes would always be alike, and there would be no such phenomenon as seasonal dimorphism.

As a matter of fact, the portions of the egg (we call them, for the sake of clearness, colour-producing biological molecules) which give rise to the pœcilomeres exhibit themselves merely in the shape of tendencies; the ultimate form the colouring will take depends to a large extent upon other and extraneous circumstances, such as the secretion of hormones.

Thus it is that organisms seem to display an almost endless diversity of colouration. But beneath all this diversity we see something like order. It occasionally happens (*why*, we do not know) that one, or more, of the biological molecules which make up the nucleus of the fertilised ovum becomes altered in the sexual act, with the result that a discontinuous variation or mutation appears in the resulting organism. The mutation may be a favourable one, or one which does not affect in any way the chances of an organism in the struggle for existence, or an unfavourable one. In the last of the three cases the organism will perish early and not leave behind any offspring exhibiting its peculiarity.

It is thus that natural selection acts. Natural

explanation of all the peculiarities of animal structure and colouration.

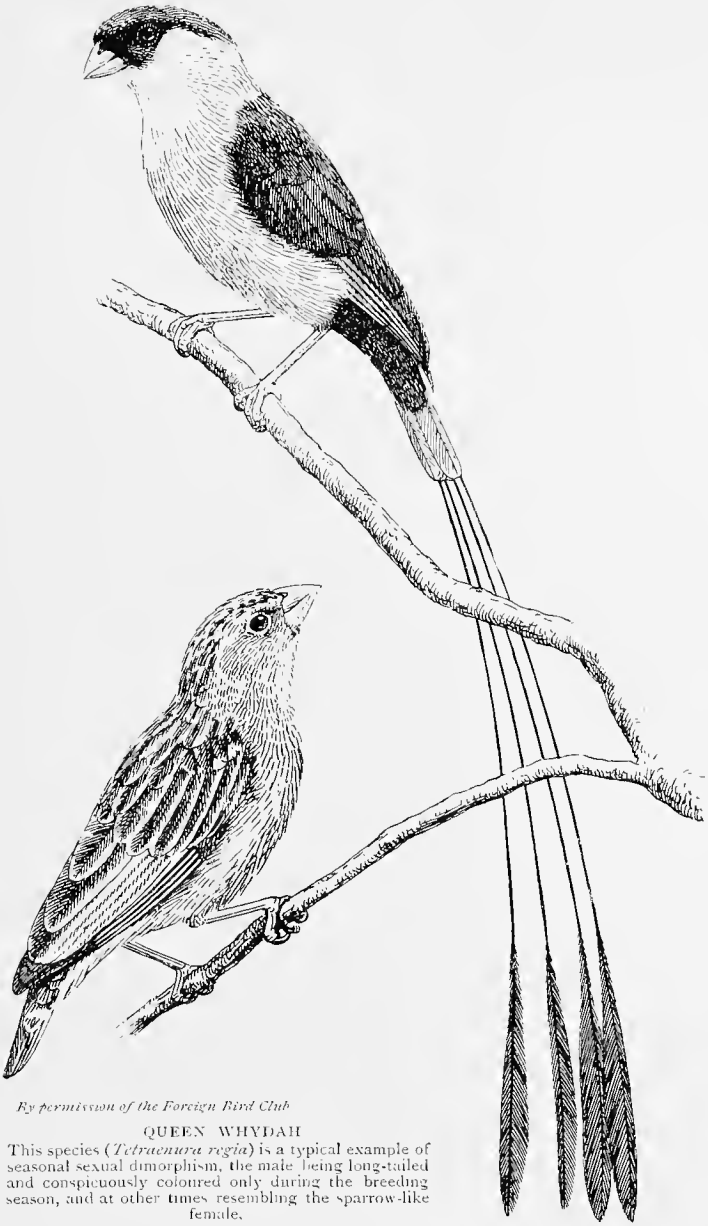
It is not easy to understand how natural selection can have caused marked sexual dimorphism in a species where the habits of the sexes are the same, in the Paradise Flycatcher (*Terpsiphone paradisi*), for example, where the cock and the hen obtain their food in the same way, and share equally the duties of nest-building, incubation, and feeding the young.

Of course, in all species where each individual carries only one of the two kinds of sexual organs, there must of necessity be some slight difference between the individuals that carry the male organ, which performs one function, and those that carry the female organ, which performs another function.

But in many species the sexes display differences which have no direct connection with the generative organs—for example, the deer, where the stag alone has horns.

Those characters which differ with the sex, but are not directly connected with the organs of reproduction, are known as secondary sexual characters.

In nearly all species where the male and female differ in beauty, it is the male who surpasses the female. Natural selection is, in many cases, not able to explain the origin of these differences, or why, when they occur, the male should be more beautiful than the



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QUEEN WHYDAH

This species (*Tetraenura regia*) is a typical example of seasonal sexual dimorphism, the male being long-tailed and conspicuously coloured only during the breeding season, and at other times resembling the sparrow-like female.

female. This Darwin saw. In order to account for the phenomena of sexual dimorphism, he formulated the theory of sexual selection. This hypothesis is based on the assumption that there is, in all species of animals, a competition among the males to secure females as mates. It is not difficult to understand how this competition arises in polygamous species. Assuming that approximately equal numbers of males and females are born (an assumption which appears to be justified as regards the majority of species), it is clear that for every male who secures more than one wife, at least one male will be obliged to live in a state of single blessedness.

But how can there be competition in the case of monogamous species? The sexes being approximately equal in number, there are sufficient females to allow of a mate for every male.

Such is the nature of things, said Darwin, that, even under these circumstances, there is competition among the males for females.

"Let us take any species," he writes, on page 329 of *The Descent of Man* (Ed. 1901), "a bird for instance, and divide the females inhabiting a district into two equal bodies, the one consisting of the more vigorous and better-nourished individuals, and the other of the less vigorous and healthy. The former, there can be little doubt, would be ready to breed in the spring before the others; and this is the opinion of Mr Jenner

Weir, who has carefully attended to the habits of birds during many years. There can also be no doubt that the most vigorous, best nourished, and earliest breeders would on an average succeed in rearing the largest number of fine offspring. The males, as we have seen, are generally ready to breed before the females; the strongest, and with some species the best armed of the males, drive away the weaker; and the former would then unite with the more vigorous and better-nourished females, because they are the first to breed. Such vigorous pairs would surely rear a larger number of offspring than the retarded females, which would be compelled to unite with the conquered and less powerful males, supposing the sexes to be numerically equal; and this is all that is wanted to add, in the course of successive generations, to the size, strength, and courage of the males, or to improve their weapons."

From this competition among the males there arise, firstly, contests between the males for mates; secondly, the preference of the females for favoured males.

It is a matter of common knowledge that at the breeding season the males of nearly all, if not all, species are very pugnacious. Two males often engage in desperate fights for one or more females; the victor drives away his foe and secures the harem. In such contests the

stronger male wins, and thus emerges that particular form of sexual selection which Darwin termed "the law of battle."

"There are," writes Darwin, on page 324 of *The Descent of Man*, "many other structures and instincts which must have developed through sexual selection—such as the weapons of offence and the means of defence of the males for fighting with and driving away their rivals—their courage and pugnacity—their various ornaments—their contrivances for producing vocal or instrumental music—and their glands for emitting odours." The former characters have, according to Darwin, been developed by the law of battle, and the latter, since they serve only to allure or excite the female, by the preference of the female.

"It is clear," continues Darwin, "that these characters are the result of sexual and not of ordinary selection, since unarmed, unornamented, or unattractive males would succeed equally well in the battle for life and in leaving a numerous progeny, but for the presence of better-endowed males. We may infer that this would be the case, because the females, which are unarmed and unornamented, are able to survive and procreate their kind. . . . Just as man can improve the breed of his game-cocks by the selection of those birds which are victorious in the cockpit, so it appears that the strongest and most vigorous

males, or those provided with the best weapons, have prevailed under nature, and have led to the improvement of the natural breed or species."

"With mammals," says Darwin (*loc. cit.*, p. 763), "the male appears to win the female much more through the law of battle than through the display of his charms."

In the case of birds, however, feminine preference comes more into play. It is well known that cocks display their charms to the hens at the breeding season, and Darwin believed that the hen selected the most beautiful of her rival suitors.

"Just as man," he writes (p. 326 of *The Descent of Man*, new edition, 1901), "can give beauty, according to his standard of taste, to his male poultry, or, more strictly, can modify the beauty originally acquired by the parent species, can give to the Sebright bantam a new and elegant plumage, an erect and peculiar carriage, so it appears that female birds in a state of nature have, by a long selection of the more attractive males, added to their beauty or other attractive qualities."

Thus the theory of sexual selection is based on three assumptions. Firstly, that there is in all species competition among the males for females with which to mate. Secondly, that this results in either "the law of battle" among

the males, or selection by the female of one among several admirers. Thirdly, that the female selects, as a rule, the most attractive of her suitors.

The evidence upon which Darwin founds this theory may be thus summarised :—

1. In cases where the sexes differ in appearance, or power of song, it is almost invariably the cock who is the more beautiful or the better singer, as the case may be.

2. All male birds that possess accessory plumes or other attractions, make a most elaborate display of these before the females at the mating season, hence "it is obviously probable that these appreciate the beauty of their suitors."

3. Darwin was able to cite specific instances in which the hens showed preference.

In the case of polygamous species there can be no doubt that there is considerable competition among males for their wives. It cannot be said that the contention is so well established in the case of monogamous species. D. Dewar suggests that circumstances may occur in which the hens have to fight for the cock, or in which the male is in the happy position of being able to select his mate. He states his belief that in many cases the selection is mutual, as in the case of human beings.

"I have seen," he writes, on page 13 of *Birds of the Plains*, "one hen Paradise Fly-

catcher (*Terpsiphone paradisi*) drive away another and then go and make up to a cock bird. Similarly, I have seen two hen orioles behave in a very unladylike manner to one another all because they both had designs on the same cock. He sat and looked on from a distance at the contest."

Darwin quotes, on page 500 of *The Descent of Man*, a case of a male exercising selection: "It appears to be rare when the male refuses any particular female, but Mr Wright of Geldersley House, a great breeder of dogs, informs me that he has known some instances: he cites the case of one of his own deerhounds who would not take any notice of a particular female mastiff, so that another deerhound had to be employed."

Similarly, Finn records, in the *Country-Side* for August 29th, 1908, that the male Globose Curassow (*Crax globicera*) in the London Zoological Gardens, which bred with the female Heck's Curassow (*C. hecki*), as related on p. 104, selected the hen of this very distinctly coloured form or species in preference to any of the typical hens of his own kind.

The cases on record of cocks being in a position to select their mates are comparatively rare, while instances of selection on the part of the hens are far more numerous.

Hence it would seem that the sex, which is in a minority, and so has the opportunity of select-

ing a mate, does exert a choice and prefer one particular individual; and that, for the reasons pointed out by Darwin, it is in most cases the female who is in the position of being able to pick and choose her mate. It is, as Darwin truly said, far more difficult to decide what qualities determine the choice of the female. He believed that it is "to a large extent the external attractions of the male, though no doubt his vigour, courage, and other mental qualities come into play."

Darwin argued that it is the love of hen birds for "external attractions" in cock birds that has brought into being all the wonderful plumes that characterise such birds as the peacock. "Many female progenitors of the peacock," he writes, on page 661 of *The Descent of Man* (ed. 1901), "during a long line of descent, have appreciated this superiority, for they have unconsciously, by the continued preference of the most beautiful males, rendered the peacock the most splendid of living birds."

This conclusion has been vigorously attacked. It is argued, with some show of reason, that it is absurd to credit birds with æsthetic tastes equal, if not superior, to those of the most refined and civilised of human beings.

Is it likely, it is asked, that a bird, which will nest in an old shoe cast off by a tramp, can appreciate beauty of plumage?

As Geddes and Thomson say (page 29 of *The Evolution of Sex*), "When we consider the complexity of the markings of the male bird or insect, and the slow gradations from one step of perfection to another, it seems difficult to credit birds or butterflies with a degree of æsthetic development exhibited by no human being without special æsthetic acuteness and special training. Moreover, the butterfly, which is supposed to possess this extraordinary development of psychological subtlety, will fly naively to a piece of white paper on the ground, and is attracted by the primary æsthetic stimulus of an old-fashioned wall-paper, not to speak of the gaudy and monotonous brightness of some of our garden flowers. Thus we have the further difficulty, that we must suppose the female butterfly to have a double standard of taste, one for the flowers which she and her mate both visit, the other for the far more complex colourings and markings of the males. And even among birds, if we take those unmistakable hints of real awakening of the æsthetic sense which are exhibited by the Australian bower-bird or by the common jackdaw in its fondness for bright objects, how very rude is his taste compared with the critical examination of infinitesimal variations of plumage on which Darwin relies. Is not, therefore, his essential supposition too glaringly anthropomorphic?

"Again, the most beautiful males are often extremely combative; and on the conventional view this is a mere coincidence, yet a most unfortunate one for Mr Darwin's view. Battle thus constantly decides the question of pairing, and in cases where, by hypothesis, the female should have most choice, she has simply to yield to the victor."

Darwin, with characteristic fairness, quotes some instances which appear to be opposed to the theory that the hen selects the most beautiful of her suitors. He informs us that Messrs Hewitt, Tegetmeier, and Brent, who have all had a long experience of domesticated birds, "do not believe that the females prefer certain males on account of the beauty of their plumage. . . . Mr Tegetmeier is convinced that a game-cock, though disfigured by being dubbed and with his hackles trimmed, would be accepted as readily as a male retaining all his natural ornaments. Mr Brent, however, admits that the beauty of the male probably aids in exciting the female; and her acquiescence is necessary. Mr Hewitt is convinced that the union is by no means left to mere chance, for the female almost invariably prefers the most vigorous, defiant, and mettlesome male"; and, in consequence, when there is a game-cock in the farmyard, the hens will all resort to him in preference to the cock of their own breed. Darwin thinks that "some

allowance must be made for the artificial state in which these birds have long been kept," and cites in his favour the case of Mr Cupples' female deerhound that thrice produced puppies, and on each occasion showed a marked preference for one of the largest and handsomest, but not the most eager, of four deerhounds living with her, all in the prime of life.

The question what is it that determines the choice of the female is obviously one of considerable importance, and it was to be expected that many zoologists would have conducted experiments with a view to deciding it. This legitimate expectation has not been realised.

The matter of sexual selection remains to-day practically where Darwin left it. Wallace rejects the whole theory, and believes that natural selection alone can explain all the phenomena of sexual dimorphism. To such an extent does the enticing idea of the all-puissance of natural selection dominate the minds of scientific men that but few of them have paid any attention to the question of sexual selection. This neglect of the subject affords an example of the baneful results of the too-ready acceptance of an enticing theory, "Natural selection explains everything, why then investigate further?" seems to be the general attitude of our present-day naturalists.

Edmund Selous and D. Dewar have made some observations on birds, and the Peckhams

on spiders, in a state of nature. Such observations demonstrate that selective mating occurs in nature, but, for the most part, fail to show what it is that determines the choice.

D. Dewar, however, states (*Birds of the Plains*, p. 42) that the coloured peahens in the Zoological Gardens at Lahore show a decided preference for the white cocks, which are kept in the aviary along with normally coloured cocks. He gives it as his opinion that "the hens select the white cocks, not because they are white, but because of the strength of the sexual instincts of these latter. The white cocks continually show off before the hens ; the sexual desire is developed more highly in them than in the ordinary cocks, and it is this that attracts the hens."

The only zoologists who have investigated experimentally the question of sexual selection appear to be Karl Pearson and Frank Finn. The former tried to determine, by actual measurements, whether there is any preferential mating among human beings as regards physical characteristics. "Our statistics," he writes, on page 427 of *The Grammar of Science*, "run to only a few hundreds, and were not collected *ad hoc*. Still, as far as they go, they show no evidence of preferential mating in mankind on the basis of stature, or of any character *very* closely correlated with stature. Men do not appear, for example, to select tall women for

their wives, nor do they refuse to mate with very tall or very short women." As regards eye-colour, Pearson seems to have arrived at somewhat more definite results. "We conclude," he writes (p. 428), "that in mankind there certainly exists a preferential mating in the matter of eye-colour, or of some closely allied character in the male; in the case of the female there also appears to be some change of type due to preferential mating. . . . The general tendency is for lighter-eyed to mate, the darker-eyed being relatively less frequently mated."

But Pearson's experiments seem to show that as regards stature and eye-colour there is "a quite sensible tendency of like to mate with like." "In fact," writes Pearson, "husband and wife for one of these characters are more alike than uncle and niece, and for the other more alike than first cousins." He adds, "Such a degree of resemblance in two mates, which we reasonably assume to be not peculiar to man, could not fail to be of weight if all the stages between like and unlike were destroyed by differential selection."

Two obvious criticisms of the results obtained by Prof. Pearson occur to us. The first is that his conclusions do not seem to be in accordance with the popular notion that fair-haired men prefer dark hair in a woman, while dark-haired men prefer fair-haired women, and *vice versa.*

The second is that the human animal is not a typical one. Husbands and wives are selected for mental and moral qualities rather than physical ones. The same may, of course, be to some extent true of animals, but in these there must of necessity be far less variation as regards mental attributes. Moreover, the question of income is much bound up with human matrimonial alliances; a rich man or woman has the same advantage in selection as is possessed by an animal endowed with more than the average physical strength of its species.

Finn adopted the plan of experiment suggested by Prof. Moseley. His apparatus consisted of a cage divided into three compartments by wire partitions, so that a bird living in one of them could see its neighbour in the next compartment. In the middle compartment he placed a hen Amadavat (*Sporæginthus amandava*), and in each of the other compartments he put a cock bird. Under such circumstances, the hen in the middle compartment will sit and roost beside the cock she prefers. The male amadavat, he writes, in *The Country-Side*, vol. i. p. 142, "is in breeding plumage red with white spots, and the hen brown. The red varies in intensity even in full-plumaged birds, and I submitted to the hen first of all two male birds, one of a coppery and the other of a rich scarlet tint. In no long time she had made her choice of the latter bird; the other, I am sorry

to say, very soon died; and, as he had appeared perfectly healthy, I fear grief was accountable for his end—a warning to future experimenters to remove the rejected suitor as early as possible. In the present case I took away the favoured bird, and put in the side compartments he and his rival had occupied two other cocks, which differed in a similar way, though not to the same extent. Again the hen kept at the side of the rich red specimen, so, deeming I knew her views about the correct colour for an amadavat, I took her away too, and tried a second hen with these two males. This was an unusually big bird, and a very independent one, for she would not make up her mind at all, and ultimately I released all three without having gained any result.

Subsequently I made another experiment with linnets. In this case all three were allowed to fly in a big aviary-cage together, a method which I do not recommend.

In this case, however, the handsomest cock, which showed much richer red on the breast, had a crippled foot, and proved, as I had expected, to be in fear of the other; nevertheless, the hen mated with him. It must be said, in justice to the duller bird, that he did not press the advantage his soundness gave him, but with a less gentle bird than the linnet this would have happened."

It is obvious that there is a wide field for observation on these lines. In the case of large birds the experiment could be made still more conclusive by confining the three birds to be experimented on in a single enclosure, divided into three compartments by fences. The males should be placed each in a separate compartment, and have a wing clipped so as to prevent them leaving their respective compartments, while the hen should be allowed the power of flight so that she can visit at will any compartment.

Finn has also recorded (*loc. cit.*) some other observations bearing on the question of sexual selection. He writes:—

"One cannot observe or read about the habits of birds very much without finding out that, whatever may be the value of beauty, strength counts for a great deal. Male birds constantly fight for their mates, and the beaten individual, if not killed, is at any rate kept at a distance by his successful rival, so that, if he be really more beautiful, his beauty is not necessarily of much service to him. I was particularly impressed by this about a couple of years ago, when I frequently watched the semi-domesticated mallards in Regent's Park in the pairing season. These birds varied a good deal in colour; in some the rich claret breast was wanting, and others had even a slate-coloured head instead of the normal brilliant green. Yet I found these

'off-coloured' birds could succeed in getting and keeping mates when correctly-dressed drakes pined in lonely bachelorhood; one grey-breasted bird had even been able to indulge in bigamy. That strength ruled here was obvious from the way in which the wedded birds drove away their unmated rivals, a proceeding in which their wives most thoroughly sympathised.

"Evidently, beauty does not count for much with the park duck, and the same seems to be the case with the fowl. As a boy, I often used to visit a yard wherein was a very varied assortment of fowls. Among these was one very handsome cock, of the typical black and red colouring of the wild bird, and very fully 'furnished' in the matter of hackle and sickle feathers. Yet the hens held him in no great account, while the master of the yard, a big black bird, with much Spanish blood, provided with a huge pair of spurs, was so admired that he was always attended by some little bantam hens, although they might have had diminutive husbands of their own class.

"It must be remembered, however, that these ducks and fowls had an unnaturally wide choice. In nature, varieties are rare, and the competing suitors are likely to be all very much alike; this makes matters very difficult for the observer, who may easily pass over small differences which are plain enough to the eyes of the hen birds."



COURTSHIP OF SKYLARK
Illustrating display by a species with no decorative colouring or sex difference.

Finn observed that a young hen Bird of Paradise (*Paradisea apoda*) in the London Zoological Gardens, mated with a fully adult cock in the next compartment although a young cock in female plumage in her own compartment did his best to show off.

It would thus seem that the very limited evidence at present available is not sufficient to sustain the theory that the hens select the most attractive of their suitors. It is significant that plainly-coloured species of birds show off with as much care as their gaily-plumaged brethren; and, if they be nearly allied, assume similar courting attitudes. Thus the homely-attired males of the Spotted-bill (*Anas poecilorhyncha*), Gadwall, and Black Duck (*Anas superciliosa*), show off in precisely the same way as does the handsome mallard.

Howard describes and figures in his excellent and beautifully illustrated monograph the elaborate display at the pairing season of some of our plain-coloured little warblers. The skylark has also a notable display.

The common partridge assumes a nuptial attitude similar to that of the pheasant, and, although the cock of the former species has nothing brilliant to show off, the hen partridge pays far more attention to the display of her suitor than does the hen pheasant.

The fact that some cock birds show off *after* the

act of pairing seems to tell against the theory of sexual selection, or at any rate to indicate the purely mechanical nature of the performance. Finn has witnessed this post-nuptial display at the Zoological Gardens (London) in the pied wagtail, the peacock, the Andaman Teal (*Nettium albigulare*), the Avocet, the Egyptian Goose (*Chenatopex ægyptiaca*), and the Maned Goose (*Chenonetta jubata*).

Another objection to the theory that the bright colours of cock birds are due to feminine selection is presented by those birds which breed in immature plumage. Darwin admits that this objection would be a valid one "if the younger and less ornamental males were as successful in winning females and propagating their kind as the older and more beautiful males. But," he continues, "we have no reason to suppose that this is the case."

Unfortunately for the theory of sexual selection, there is evidence to show that the cock Paradise Fly-catcher (*Terpsiphone paradisi*) in immature plumage is quite as successful in obtaining a mate as is the cock in his final plumage. The cock of this beautiful species has a chestnut plumage in his second year, and a white one in the third and subsequent years of his life. Nevertheless, a considerable proportion of the nests found belong to chestnut cocks.

Darwin was of opinion that any novelty in

colouring in the male is admired by the female; and in this manner he sought to overcome some difficulties to his theory which certain birds presented.

Writing of the heron family, he says :—

"The young of the *Ardea asha* are white, the adults being slate-coloured; and not only the young, but the adults of the allied *Buphus coromandus* in their winter plumage are white, their colour changing into a rich golden buff during the breeding season. It is incredible that the young of these two species, as well as of some other members of the same family, should have been specially rendered pure white, and thus made conspicuous to their enemies; or that the adults of one of these two species should have been specially rendered white during the winter in a country which is never covered with snow. On the other hand, we have reason to believe that whiteness has been gained by many birds as a sexual ornament. We may therefore conclude that an early progenitor of the *Ardea asha* and the *Buphus* acquired a white plumage for nuptial purposes, and transmitted this colour to their young; so that the young and the old became white like certain existing egrets, the whiteness having afterwards been retained by the young whilst exchanged by the adults for more strongly pronounced tints. But if we could look still further backwards in time to

the still earlier progenitors of these two species, we should probably see the adults dark-coloured. I infer that this would be the case, from the analogy of many other birds, which are dark whilst young, and when adult are white; and more especially from the adult of the *Ardea gularis*, the colours of which are the reverse of those of *A. asha*, for the young are dark-coloured and the adults white, the young having retained a former state of plumage. It appears, therefore, that the progenitors in their adult condition of the *A. asha*, the *Buphus*, and of some allies have undergone, during a long line of descent, the following changes of colour: firstly a dark shade, secondly pure white, and thirdly, owing to another change of fashion (if I may so express myself), their present slaty, reddish or golden-buff tints. These successive changes are intelligible only on the principle of novelty having been admired by the birds for the sake of novelty."

This reasoning may appear far-fetched and unconvincing. It seems, however, quite likely that the hen may select as her mate the suitor who is conspicuously different from the others, not because she admires novelty, but because his conspicuousness attracts her attention and enables her to make up her mind quickly to take him and thus rid herself of the other troublesome admirers, who are all very much alike.

It is perhaps worthy of note that, after the most successful of her suitors has succeeded in securing the hen, it may happen that a disappointed rival makes love to her in the absence of her lord and master and thereby nullifies the effect of her previous selection.

It is to be observed that, even if we take it as proved, as Darwin believed, that the hens alone exercise a choice of mates, and that they select the most beautiful of their suitors, we are still far from arriving at an explanation of the fact that the males alone have acquired beauty. Admitting that the hens always mate with the most beautiful cocks, we should expect the offspring of each union to be all more or less alike in beauty—that is to say, more beautiful than the mother and less so than the cock. How are we to explain the one-sided inheritance of this beauty? Why is it confined to the cocks?

In order to meet this objection Darwin had to call to his aid unknown laws of inheritance. "The laws of inheritance," he writes (*Descent of Man*, p. 759), "irrespectively of selection, appear to have determined whether the characters acquired by males for the sake of ornament, for producing various sounds, and for fighting together, have been transmitted to the males alone or to both sexes, either permanently or periodically, during certain seasons of the year. Why various characters should have been trans-

mitted sometimes in one way and sometimes in another is not in most cases known; but the period of variability seems often to have been the determining cause. When the two sexes have inherited all characters in common, they necessarily resemble each other; but, as the successive variations may be differently transmitted, every possible gradation may be found, even within the same genus, from the closest similarity to the widest dissimilarity between the sexes."

This statement, although it does not throw any light upon the problem, is somewhat damaging to the theory of sexual selection. If it be admitted that dissimilarity between the sexes is due to the fact that the males have varied in one way and the females in another way, there seems no necessity for invoking the aid of feminine preference.

Even greater is the difficulty presented by those species in which the males alone are provided with horns or antlers. "When," writes Darwin (*Descent of Man*, p. 767), "the males are provided with weapons which in the females are absent, there can hardly be a doubt that these serve for fighting with other males; and that they were acquired through sexual selection, and were transmitted to the male sex alone. It is not probable, at least in most cases, that the females have been prevented from acquiring

such weapons on account of their being useless, superfluous, or in some way injurious. On the contrary, as they are often used by the males for various purposes, more especially as a defence against their enemies, it is a surprising fact that they are so poorly developed, or quite absent, in the females of so many animals."

We have, we believe, demonstrated that Darwin's theory of sexual selection is unable to account satisfactorily for all the phenomena of sexual dimorphism. But, as we have seen, it is quite possible that sexual selection is a real factor of evolution.

We trust that what we have said will stimulate some leisured naturalist to study the question of male and female preference.

We now pass on to consider briefly some of the other attempts that have been made to explain the phenomena of sexual dimorphism.

Wallace's Explanation of Sexual Dissimilarity

Wallace does not accept the theory of sexual selection. He admits that the form of male rivalry, which Darwin calls "the law of battle," is "a real power in nature," and believes that "to it we must impute the development of the exceptional strength, size, and activity of the male, together with the possession of special offensive and defensive weapons, and of all

other characters which arise from the development of these, or are correlated with them" (*Darwinism*, p. 283). But the view that the female selects the most beautiful of her suitors has always seemed to Wallace "to be unsupported by evidence, while it is also quite inadequate to account for the facts." For example, the accessory plumes of birds "usually appear in a few definite parts of the body. We require some cause to initiate the development in one part rather than in another."

Wallace considers that natural selection is able to explain all the phenomena of sexual dimorphism. He points out that, when the sexes are dissimilar among birds, it is almost invariably the female which is duller coloured. The reason for this is, he believes, that the hen birds, while sitting, "are exposed to observation and attack by the numerous devourers of eggs and birds, and it is of vital importance that they should be protectively coloured in all those parts of the body which are exposed during incubation. To secure this, all the bright colours and showy ornaments which decorate the male have not been acquired by the female, who often remains clothed in the sober hues which were probably once common to the whole order to which she belongs. The different amounts of colour acquired by the females have no doubt depended on peculiarities of habits and environment, and on

the powers of defence and concealment possessed by the species."

In support of his contention, Wallace asserts that all species of birds, of which the hens are as conspicuously coloured as the cocks, nest in holes or build domed nests. The plumes and other ornaments, which the cocks of certain species display, Wallace would attribute to a surplus of strength, vitality, and growth power, which is able to expend itself in this way without injury.

"If," he writes, "we have found a *vera causa* for the origin of ornamental appendages of birds and other animals in a surplus of vital energy, leading to abnormal growths in those parts of the integument where muscular and nervous action are greatest, the continuous development of these appendages will result from the ordinary action of natural selection in preserving the most healthy and vigorous individuals, and the still further selective agency of sexual struggle in giving to the very strongest and most energetic the parentage of the next generation." (*Darwinism*, p. 293.) "Why," he says, "in allied species the development of accessory plumes has taken different forms we are unable to say, except that it may be due to that individual variability which has served as the starting point for so much of what seems to us strange in form, or fantastic in colour, both in the animal and vegetable world."

Wallace's view that the dull plumage of the hen bird is due to her greater need of protection is based on the assumption that the hen bird alone takes part in incubation.

Is this assumption a correct one?

It certainly is not in all cases. As D. Dewar has stated in *Birds of the Plains*, the showy white cock Paradise Fly-catcher (*Terpsiphone paradisi*) sits in broad daylight on the open nest quite as much as the hen does. And this may prove to be true of many other species of birds. Again, the cocks of the various species of Indian sunbirds are brightly coloured while the hens are dull brown. In these species the hen alone sits on the eggs, but, as the nest is well covered-in, the hen might display all the colours of the rainbow without being visible to passing birds. Moreover, as D. Dewar pointed out in a paper read before the Royal Society of Arts (*Journal*, vol. lvii., p. 104), although, in most species of Indian dove, the sexes show little or no dissimilarity, there is one species (*Œnopopelia tranquebarica*) which exhibits considerable sexual dimorphism. But the nesting habits of this peculiar species are in all respects similar to those of the other species of dove. Why then the marked dissimilarity of the sexes?

Another objection to the theory of Wallace is that urged by J. T. Cunningham (*Archiv für*

Entwicklungsmechanik der Organismen, vol. xxvi., p. 378), namely, that the secondary sexual characters in those species which possess them show an entire absence of uniformity in nature and position. "Why," asks Cunningham, "should the male constitution of the stag show itself in bony excrescences of the skull, in the peacock in excessive growth of the other end of the body? Why should the larynx be modified in one mammal, the teeth in another, the nose in another? Why is the male newt distinguished by a dorsal fin, the male frog by a swelling on the fore foot?"

Another objection to the explanation of sexual dimorphism suggested by Wallace, is that in many species of bird, as, for example, the house sparrow and the green paroquets of India, the external differences between the sexes are so slight that it is unreasonable to believe that they are the result of natural selection. It seems impossible to hold that the Rose-ringed Paroquet (*Palaeornis torquatus*)—a species which nests in holes—would have become extinct if the hens had developed the narrow rose-coloured collar that characterises the cocks.

Darwin pointed out that while Wallace's hypothesis might appear plausible if applied to colour, it can scarcely be said to explain the origin of such structures as the musical apparatus of certain male insects, or the larger size of the

larynx in some birds and mammals. We thus see that suggestions offered by Wallace, although they contain a modicum of truth, fail to explain the phenomena of sexual dimorphism.

The fairest possible criticism of these views is that of Darwin :—

"It will have been seen that I cannot follow Mr Wallace in the belief that dull colours, when confined to the females, have been in most cases specially gained for the sake of protection. There can, however, be no doubt, as formerly remarked, that both sexes of many birds have had their colours modified, so as to escape the notice of their enemies ; or in some instances, so as to approach their prey unobserved, just as owls have had their plumage rendered soft, that their flight may not be overheard" (*The Descent of Man*, p. 745).

The Theory of Thomson and Geddes

Thomson and Geddes have attempted to explain sexual dimorphism on the hypothesis that males are essentially dissipators of energy, while females tend to conserve energy. They point out that the spermatozoon is a small intensely active body, which dissipates its energy in motion, while the ovum is a large inert body —the result of the female tendency to conserve energy and to build up material. The various ornaments and excrescences which appear in

male organisms are the result of this male tendency to dissipate energy. In the spermatozoon the dissipated energy appears in the form of active movement; in the adult organism it takes the shape of plumes and other ornaments, of song and contests for the females.

This theory, however, does not explain what we might call the haphazard nature of sexual dimorphism. If sexual dissimilarity is due to the tendency of the male to dissipate energy, why do we see very marked dimorphism in one species, and no dimorphism in a very nearly allied species? Why are the males larger than the females in some species, and smaller in other species? Again, how is it that in certain species of birds—the quails of the genus *Turnix*, the Painted Snipe (*Rhynchæa*), and the Phalaropes—it is the female who possesses the more showy plumage? Moreover, this theory, equally with that of Wallace, does not explain why the excrescences which characterise the male appear in various parts of the body in different species.

Stolzmann's Theory

Stolzmann has made an ingenious attempt to explain why in birds the cock is so frequently more conspicuously coloured than the hen. He asserts that among birds the males are more numerous than the females, and that this preponderance is not advantageous to the species.

Those males which have not managed to secure a mate are apt to persecute the females while sitting on the eggs, to the detriment of these latter. Natural selection, says Stolzmann, is concerned with the well-being of the species rather than of the individual. Hence anything that would tend to lessen the number of males would be a good thing for the species, so that a peculiarity, such as bright plumage, which renders the males conspicuous, or ornamental plumes, which cause their flight to be slow, and so leads to their destruction, will be seized upon and perpetuated by natural selection. He points out that the cock of one species of humming-bird—*Loddigesia mirabilis*—has not only longer tail feathers, but a shorter wing than the female, and must, in consequence, find it comparatively difficult to obtain food, and be more liable to fall a victim to birds of prey than the hen. Stolzmann further suggests that the excessive pugnacity of male birds at the breeding season may lead to the destruction of some individuals, and so prove of advantage to the species.

Several objections seem to present themselves to this most ingenious theory.

In the first place, there does not appear to be any satisfactory evidence to show that more cocks than hens are born.

We may grant that a superfluity of cocks is injurious to any species, since the unmated ones

are likely to persecute the hens; we may also grant that many cocks are handicapped in the struggle for existence by the excessive growth of certain of their feathers, but we fail to see how this excessive development has been caused by natural selection in the manner suggested by Stolzmann. Although it may be advantageous to the species for the cocks to be showy, natural selection can perpetuate this only by weeding out the least conspicuous of the cocks. But it is the more gaudy ones, those, according to Stolzmann, whose presence is beneficial to the species, which will be eliminated by natural selection. So that, in this case, that force will act in a manner contrary to the interests of the species, if Stolzmann's idea is a correct one.

The theory in question would therefore seem to be untenable. Nevertheless there is doubtless some truth in the notion that too many males spoil the species. Thus, excessive showiness and high mortality among the males may be beneficial to the species. But we must not forget that the more beneficial it is, the stronger must be the tendency of natural selection to eliminate the males that possess the desired peculiarity.

Neo-Lamarckian Explanation

J. T. Cunningham makes an attempt to explain the phenomena of sexual dimorphism on

Neo-Lamarckian principles. His theory is set forth in a paper entitled *The Heredity of Secondary Sexual Characters in relation to Hormones*, which was read before the Zoological Society of London, and published in full in the *Archiv für Entwicklungsmechanik der Organismen*. "The significant correlation of male sexual characters," he writes, "is not with any general or essential property of the male sex, such as katabolism (or the tendency to dissipate energy, as we have called it), but with certain habits and functions confined to one sex, but differing in different animals. . . . In those animals which possess such (*i.e.* secondary sexual) characters, the parts of the soma (*i.e.* the body) affected differ as much as they can differ; any part of the soma may show a sexual difference: teeth in one mammal, skull in another; feathers of the tail in one bird, those of the neck in another, and so on. But in all cases such unisexual characters correspond to their functions or use in habits and instincts which are associated, but only indirectly, with sexual production. These habits are as diverse and as irregular in their distribution as the characters. The cocks of common fowls and of the Phasianidæ generally are polygamous, fight with each other for the possession of the females, and take no part in incubation or care of the young, and they differ from the hens in their enlarged

brilliant plumage, spurs on the legs, and combs, wattles, or other excrescences on the head. In the Columbidæ *per contra* the males are not polygamous, but pair for life, the males do not fight, and share equally with the females in parental duties.

"Corresponding with this contrast of sexual habits is the contrast of sexual dimorphism, which is virtually absent in the Columbidæ.

"I think, then, the only scientific explanation is that the difference of habits is the cause of the sexual dimorphism, and that the special sexual habits which occur in some species but not in others are the causes of the sexual characters. . . . The habits in question always involve certain definite stimulations applied to those parts of the body whose modification constitutes the somatic sexual characters. The stimulations are confined, as the characters are confined, to one sex, to one period of life, to one season of the year, to those animals which have the characters, to those parts of the body which are modified." Mr Cunningham believes that these stimulations cause hypertrophy or excessive growth of the part affected, and that this peculiarity is transmitted to the offspring. And thus he supposes all the ornaments and excrescences of the males of various species to have arisen.

As evidence in favour of his view, he points out that these excrescences are, in many species,

not only functionless but absolutely injurious, as in the case of the comb and wattles of the jungle cock and his domestic descendants, which merely serve as a handle for enemies to seize.

Cunningham asserts that the only objection to his theory is the dogma that acquired characters cannot be inherited. This assertion is, however, not correct. It is, indeed, a very serious objection that all the evidence available seems to show that acquired characters are not inherited, but this is by no means the only difficulty.

Before mentioning these further objections, let us say a word on the subject of the inheritance of acquired characters. Mr Cunningham himself compares the formation of a splint or spavin in a horse as the result of special strain, to the acquisition of secondary sexual characters. Unfortunately for Cunningham's theory, but fortunately for mankind in general, spavined horses and mares do not beget spavined offspring. If, then, spavin is not inherited, is it not unreasonable to assert that the thickening of the bone that develops on the head of a butting animal is inherited?

Another objection to Cunningham's theory is that many birds which show off their plumage most vigorously possess no ornamental plumes. As Howard has recorded, many of our dull-coloured British warblers show off in the same manner as bright-coloured birds do. If the

exercise has caused the development and inheritance of plumes in some species, why not in the others?

Again, Cunningham is not correct in saying that sexual dimorphism is "virtually absent" in the Columbidæ. Few birds display so striking a sexual dimorphism as the Orange Dove (*Chrysœna victor*) of Fiji, in which the male is bright orange and the hen green. We have already cited the case of the curious sexually dimorphic red turtle-dove. Now, the courting attitudes and actions of this species are precisely the same as those of other allied turtle-doves; why, then, have these exercises caused only one species to become sexually dimorphic?

Our survey of the more important attempts which have been made to explain the phenomena of sexual dimorphism leads to the conclusion that these still require elucidation. We have weighed each theory in the balance and found it wanting.

The outstanding feature of sexual dissimilarity is the apparently haphazard manner of its occurrence.

We have already alluded to the case of the doves in India. In that country four species are widely distributed—namely, the Spotted Dove (*Turtur suratensis*), the Ring or Collared Dove (*Turtur risorius*), the Little Brown Dove (*Turtur cambayensis*), and the Red Turtle-dove (*Œnopopelia*

trangebarica). The habits of all these four species appear to be identical, nevertheless in the first three the sexes show little or no dissimilarity in outward appearance, while in the last the sexual dimorphism is so great that the cock and hen were formerly thought to belong to different species.

Another very curious case is that of the South American geese of the genus *Chloëphaga*, in which some species, as the familiar Upland or Magellan Goose of our parks (*C. magellanica*), have the sexes utterly unlike, while in others, as the Ruddy-headed Goose (*C. rubidiceps*), they are quite similar to each other.

The ducks furnish us with another very good example of the apparently haphazard nature of sexual dimorphism. In the Common Mallard or Wild Duck (*Anas boscas*) the cock is far more showily coloured than the hen, but in all the species most nearly allied to it the males are as inconspicuous as the females, *e.g.* in the Indian Spotted-bill (*Anas pœcilorhyncha*), the Australian Grey Duck (*A. superciliosa*), the African Yellow Bill (*Anas undulata*), and the American Dusky Duck (*A. obscura*). As the dusky duck inhabits North America, where the mallard is also found, the case is particularly striking.

Among mammals the lion and the tiger and the sable and roan antelopes (*Hippotragus niger* and *H. equinus*) furnish familiar examples of nearly-

related species, in one of which the sexes are alike and in the other dissimilar in appearance.

Another important point to be borne in mind is the intimate correlation that exists between the reproductive organs and the general appearance of the organism, more especially of the secondary sexual characters. These last, in most cases, do not show themselves until the maturity of the sexual organs. The well-known effects of castration illustrate this connection. Again, females in which the reproductive organs have ceased to be functional often assume male characters.

It has lately been proved by experiment that, in many cases at any rate, the development of the ornaments, etc., characteristic of the sexes is due to the secretion by the sexual cells of what are known as hormones—that is to say, secretions which excite development of the secondary sexual characters. The tendency to produce the external characteristics of the sex to which an organism belongs is inherited, but the actual development thereof is in many cases dependent on the secretion of these hormones. Accordingly, if a male individual be completely castrated it ceases to develop the external characters of its sex. The evidence upon which the doctrine of hormones is based is admirably summarised in the above-quoted paper by Cunningham. Into this evidence we cannot go. It must suffice that the doctrine is quite

in accordance with all the observed results of castration.

It is worthy of notice that the various features which characterise the sexes in sexually dimorphic animals are not associated with any particular organ or parts of the body, nor do they necessarily affect the same part in allied species. "We cannot say," writes J. T. Cunningham, "that any part of the soma (*i.e.* the body tissue) is specially sexual more than another part, except that such differences between the sexes are usually external. They usually affect the skin, and especially epidermic appendages, and the superficial parts of the skeleton, or whole limbs and appendages; or the difference may be one of size of the whole soma. In mammals and birds the male is often the larger, sometimes very much so, but there are cases in which the female is larger. There is no general rule."

Another important point is, that females, although they themselves show no trace of the male character, are capable of transmitting it to their progeny. This can be proved by crossing a hen pheasant with a cock barn-door fowl; the male offspring of the union display the plumes so characteristic of the cock pheasant. These cannot have been derived from the barn-door-fowl father; they must have come from the dull-coloured hen pheasant.

In this connection we may mention the curious

fact recorded by Bonhote, on page 245 of the *Proceedings of the Fourth International Ornithological Congress*, that in the case of ducks descended from crosses between the pintail, the mallard, and the spotbill, the drakes in full breeding plumage showed a mixture of pintail and mallard characteristics, while, in their non-breeding plumage, the colouring of the spotbill is predominant.

An important point, and one which does not seem to have been pointed out by any zoologist, is that eye-colour, comb, and spurs in birds and horns in mammals do not stand in the same relation to the sexual organs as do the other external characteristics. For example, the castrated Nilgai (*Boselaphus tragocamelus*) acquires horns, but not the characteristic male colour. In the common Indian Francolin Partridge (*Francolinus pondicerianius*), the cock differs from the hen only in the possession of spurs. The same applies to the various species of Snow Cock (*Tetraogallus*). There is a breed of game-cocks which display plumage like that of the hen, but such birds have the comb and spurs developed as in normally feathered cocks.

The white eye of the white-eyed Pochard Drake (*Nyroca africana*), and the yellow eye of the cock Golden Pheasant (*Chrysolophus pictus*), which are purely male characters, show themselves earlier than the male plumage. Occasion-

ally a hen golden pheasant assumes the plumage of the cock, but she never acquires the yellow eye.

Many birds when kept in captivity lose some of the beauty of their plumage, and this is usually attributed to the sexual organs becoming impaired and reacting on the somatic tissue. But this explanation cannot in all cases be the correct one, because the linnet, although losing the male plumage in captivity, lives long and well in a cage and breeds readily with hen canaries.

Another curious fact is that the male plumage sometimes appears pathologically in hen birds, more especially in those which have become sterile from age or disease. This phenomenon occurs comparatively frequently in the gold pheasant, and more rarely in the common pheasant, the fowl, and the duck.

Phenomena such as these seem to suggest that in some cases the bright colours of the male may be pathological, that the hormones which the male sexual cells secrete may exercise an injurious effect on the somatic or body tissues. Decay is known to be accompanied by the production of brightly coloured pigment in the case of leaves. Finn suggests that the white plumage which the cock paradise fly-catcher assumes in the fourth year of his existence may be a livery of decay, a sign of senility.

The Four Kinds of Mutations

It is our belief that sexual dimorphism arises frequently, if not invariably, as a mutation. Mutations may be of four different kinds.

Those which appear only, or especially, in conjunction with the male organs, for example, whiteness in domesticated geese allowed to breed indiscriminately.

Those which appear only, or especially, in conjunction with the female organs; mutations of this description appear to be very rare, but it may be noted that in fowls allowed to breed indiscriminately, as in India, completely black hens are common, but completely black cocks are rarely, if ever, seen. This indicates an association between blackness and femininity.

Those which appear in the same manner in both sexes. The great majority of mutations appear to be of this kind.

Lastly, those that appear in both sexes but take a different form in the case of the two sexes; thus in cats a mutation has given rise to sandy males and tortoise-shell females. The mutation which has produced the black-winged peacock shows itself in the form of a black wing in the cock, while it causes the plumage of the hen to be grizzly white.

We shall deal with the phenomenon of correlation at some length in the next chapter. It is a subject to which sufficient attention has not been paid. Even as certain characters are correlated

in certain species, so in some cases are certain characters correlated with sex.

Why this should be so we are not in a position to say; this, however, does not affect the indisputable fact that such correlation does exist.

Physicians in the course of their practice sometimes come across very curious cases of correlation in human beings.

"It is," writes Thomson (*Heredity*, p. 290), "an interesting fact that an abnormal element in the inheritance may find expression in the males only or in the females only. If we could understand this we should be nearer understanding what sex really means.

"Hæmophilia, or a tendency to bleeding, is a heritable abnormality, partly associated with weakness in the blood-vessels, which do not contract as they should and are apt to break, and partly connected with a lack of coagulating power in the blood. It is usually confined to males. But as it passes from a father through a daughter to a grandson, and so on, it must be a latent part of the germinal inheritance of the females, though for some obscure physiological reason it fails to find expression in them, or has its expression quite disguised. Colour-blindness or Daltonism has been recorded (Horner) through the males only of seven generations. Dejerine cites another case (*fide* Appenzeller) in which all the males in a family history had cataract through

four generations. There are other instances of what is sometimes awkwardly called the unilateral transmission of abnormal qualities. Edward Lambert, born in 1717, is said to have been covered with 'spines.' His children showed the same peculiarity, which began to be manifest from the sixth to the ninth month after birth. One of his children grew up and handed on the peculiarity to another generation. Indeed, it is said to have persisted for five generations, and in the males only—unilateral transmission."

In our view, these abnormalities are of such a kind that they are only possible in connection with the male organ; in other words, they are mutations of the first of the four kinds cited above—those which appear only in connection with the male organ.

It is a curious fact that the general rule in nature seems to be that the male is ahead of the female in the course of evolution. The sexes may be alike at a given period in the life-history of the species. Presently a mutation appears which is confined to the male alone; thus arises the phenomenon of sexual dimorphism. The next step in the evolution of the species is frequently a mutation on the part of the female which brings her once again into line with the male, and so the sexual dimorphism disappears, for a time at any rate. A good example of this is furnished by the sparrows; in the common

sparrow of a large part of Africa (*Passer swainsoni*) both sexes are very plain, like the hen of the house-sparrow; in this species (*P. domesticus*), as every one knows, the cock, though by no means brilliant, is noticeably handsomer than his mate; while in the Tree-sparrow (*P. montanus*) both sexes have a plumage of masculine type, much like that of the cock house-sparrow.

If we consider in conjunction with one another the various facts we have cited above, we begin to grasp the nature of the phenomena of sexual dimorphism.

Let us consider an imaginary case of a defenceless little bird which builds an open nest. Let us suppose that it is inconspicuously plumaged. Now suppose that a mutation of the first kind shows itself, a mutation which affects the cock only and makes him more conspicuous. Let us further suppose that the cock does not share in the duties of incubation. It is quite possible that, in spite of this apparently unfavourable mutation, the species may survive, for, as we have seen, it does not affect the hen, and she, since she alone incubates, stands the most in need of protective colouring. Moreover, as Stolzmann has suggested, the species can possibly afford to lose a few males. But suppose that both cock and hen share in the duties of incubation, it is then quite likely that the muta-

tion will cause the species to become extinct, by the elimination of all the males. Or, let us suppose that the mutation in the direction of showy plumage affects both sexes, then in such a case the species will almost certainly become extinct. If, however, the hypothetical species nested in holes in trees, it is quite possible that it might survive notwithstanding its showy plumage.

Whether, as Wallace suggests, the hen does most of the incubating, and is exposed to special danger when sitting on her eggs in an open nest, or, as Stolzmann urges, it is of advantage to the species that there should not be too many males, the result is the same, that the species can afford to allow the cock to be more gaily attired than the hen. In either case the colouration of the cock becomes a matter of comparatively little importance to the species, and this, coupled with the fact that the male tends to mutate more readily than the female, will explain why, in most species which exhibit sexual dimorphism, it is the cocks that are the more conspicuous. In certain species the cocks alone incubate, and these then become more important than the females to the race, so that they have not been permitted to become showy, while the hens have been allowed more freedom in this respect. The extreme variability of the Ruff (*Pavoncella pugnax*) in breeding plumage points to the

fact that his colour is a matter of comparative indifference to the species; in consequence plenty of latitude is allowed to his tendency to vary.

Our view, then, is that evolution proceeds by mutations, which may be large or small.

The mutation is the result of a rearrangement in part or parts of the fertilised egg, and this rearrangement shows itself in the adult organism as a change in one or more of its characteristics. The mutation may be correlated with only one of the sexual organs, and when this is the case, it gives rise to the phenomenon of sexual dimorphism. The appearance in the adult of certain, if not of all, characteristics is affected by causes other than the nature of the biological molecules from which they are derived. The tendency to develop in a certain direction is there, but something else, such as the secretion of hormones from the sexual cells, is frequently necessary to enable a given tendency to fully develop itself. Thus it is that castration often affects the bodily appearance of those animals operated on. When a mutation appears, natural selection decides whether or not it shall persist.

CHAPTER VIII

THE FACTORS OF EVOLUTION

Variation along definite lines and Natural Selection are undoubtedly important factors of evolution—Whether or not sexual selection is a factor we are not yet in a position to decide —*Modus operandi* of Natural Selection—Correlation an important factor—Examples of correlation—Correlation is a subject that requires close study—Isolation a factor in evolution — Discriminate isolation—Indiscriminate isolation — Is the latter a factor?—Romanes' views—Criticism of these—Indiscriminate isolation shown to be a factor—Summary of the methods in which new species arise—Natural Selection does not make species—It merely decides which of certain ready-made forms shall survive—Natural Selection compared to a competitive examination and to a medical board—We are yet in darkness as to the fundamental causes of the Origin of Species—In experiment and observation rather than speculation lies the hope of discovering the nature of these causes.

WE have so far considered three factors of evolution. The first of these is the tendency of organisms to vary along definite lines. This is a most important factor, because, unless variation occurs in any given direction, there can be no evolution in that direction. Variations are the materials upon which the other factors, or causes, of evolution work. The second great factor is natural selection. Natural selection may be compared

to a builder, and variations to his materials. The kind of building that a builder can construct depends very largely on the material supplied to him. The Forth Bridge could not have been built had those who constructed it had no material given them but bricks and mortar. Wallaceians regard natural selection as a builder who is supplied with every kind of building material—stone, bricks, wood, iron, aluminium, in any quantities he may desire. They therefore regard natural selection as the one and only cause which determines evolution. This, however, is a wrong idea. Natural selection should rather be likened to a builder who is supplied with a limited variety of building materials, so that considerable restrictions are imposed on his building operations. The doors, windows, fireplaces, etc., are supplied to him ready-made. He merely selects which of these he will use for each building.

The third factor of evolution which we have considered is sexual selection. As we have seen, sufficient attention has not been paid to this subject, so that we are not yet in a position to say how much, if any, influence it has exercised on the course of evolution.

In addition to these three factors, there are, we believe, some others. Before proceeding to a consideration of these, it is important to study carefully the *modus operandi* of natural selection, or, in other words, the nature of the struggle for

existence, as many of the statements contained in recent books on evolution seem to us to be based upon a mistaken conception of this important factor.

As usual, Darwin's disciples have failed to improve upon the account he gave of the nature of the struggle for existence. This is set forth in Chapter III. of the *Origin of Species*.

"The causes," writes Darwin (new edition, p. 83), "which check the natural tendency of each species to increase in number are most obscure. Look at the most vigorous species; by as much as it swarms in numbers, by so much will it tend to increase still further. We know not exactly what the checks are even in a single instance." This is perfectly true. Nevertheless elaborate theories of protective and warning colouration and mimicry have been built up on the tacit assumption that the checks to the multiplication of all, or nearly all, species are the creatures which prey upon them. Possibly no Wallaceian asserts this in so many words, but it is a logical deduction from the excessive prominence each one gives to the various theories of animal colouration; for, if the chief foes of an organism are not the creatures which prey upon it, how can the particular shade and pattern of its coat be of such paramount importance to it?

We shall endeavour to show that there are checks on the increase of a species far more

potent than the devastation caused by those creatures which feed upon it. Let us, however, first briefly set forth some of the checks on the multiplication of organisms which Darwin mentions in the *Origin of Species.*

"Eggs, or very young animals," he says, "seem generally to suffer the most, but this is not invariably the case." This is, as we have already insisted, a most important point to be borne in mind, especially when considering the various current theories of animal colouration. When once the average animal has become adult its chances of survival are enormously increased.

A second check mentioned by Darwin is the limitation of food supply. "The amount of food for each species," he writes (p. 84), "of course gives the extreme limit to which each can increase; but very frequently it is not the obtaining food, but the serving as prey to other animals, which determines the average numbers of a species. Thus there seems to be little doubt that the stock of partridges, grouse, and hares on any large estate depends chiefly on the destruction of vermin. . . . On the other hand, in some cases, as with the elephant and rhinoceros, none are destroyed by beasts of prey."

We are inclined to think that neither the food limit nor the beasts of prey are a very important check on the multiplication of organisms. The

lion, for example, was never so numerous as to reach the limit of its food supply. Before the white man obtained a foothold in Africa vast herds of herbivores were to be seen in those districts where lions were most plentiful. This is a most important fact, for, if the numbers of a species are not determined by those of the animals that prey upon it, the particular colour of an organism is probably not of any direct importance to it. This cuts away the foundation of some of the generally accepted theories of animal colouration.

"Climate," writes Darwin (p. 84), "plays an important part in determining the average numbers of a species, and periodical seasons of extreme cold or drought seem to be the most effective of all checks. I estimated (chiefly from the greatly reduced numbers of nests in the spring) that the winter of 1854-55 destroyed four-fifths of the birds in my own grounds, and this is a tremendous destruction when we remember that 10 per cent. is an extraordinarily severe mortality from epidemics with man."

In our opinion, Darwin did not lay nearly enough stress upon the importance of climate as a check on the increase of species. We have seen that he stated his belief that it is the most effective of all checks. But even this is not a sufficiently strong statement of the case. It

seems to us that before this check all other checks pale into insignificance.

Darwin failed to notice the potent effects of damp. Damp is more injurious to most species than even cold or drought, as every one who has tried to keep birds in England knows. All entomologists are aware how harmful damp is to insects. Caterpillars seem to take cover under leaves to avoid damp rather than to hide themselves from birds, since these make a point, when searching for insects, of invariably looking carefully under leaves.

It is a well-known fact that a wet winter in England causes much mortality among rabbits. The increase of the rabbit in Australia is usually attributed to the fact that the little rodent has not so many predatory creatures to contend with there as it has in Europe. This is not so. In Australia the rabbit has to fight against eagles, other large birds of prey, carnivorous marsupials, feral cats, monitor lizards and large snakes, to say nothing of the well-organised and persistent attacks of man.

Were predacious creatures the most important foes of the rabbit it would never have obtained a firm foothold in Australia. Damp appears to be its chief enemy. In Australia this does not exist. Hence the remarkable increase of the species. Stronger evidence it would not be possible to advance of the potency of damp as a check on

the increase of a species and of the comparative powerlessness of the attacks of raptorial creatures.

The failure of the sandgrouse to establish a footing in England is, we believe, due to the fact that it is constitutionally unfitted to withstand our damp climate.

The camel is an animal that revels in dry habitats, hence the difficulty of keeping camels in damp Bengal, although they seem to thrive well enough in the drier parts of India.

"When a species," writes Darwin (p. 86), "owing to highly favourable circumstances, increases inordinately in numbers in a small tract, epidemics—at least, this seems generally to occur with our game animals—often ensue; and here we have a limiting check independent of the struggle for life. But even some of these so-called epidemics appear to be due to parasitic worms, which have from some cause, possibly in part through facility of diffusion amongst the crowded animals, been disproportionately favoured: and here comes in a sort of struggle between the parasite and its prey."

Thus inadequately does Darwin deal with that bar to the increase of organisms, which is only second in importance to the effect of climate. The check occasioned by disease and parasites is one to which naturalists have as yet paid but little attention. The result is a very general misunderstanding of the true nature of the

struggle for existence, in other words, of the *modus operandi* of natural selection.

The tsetse-fly in Africa is a far more important check on the increase of some animals than the lions and other beasts of prey. There are in that continent large tracts of country, known as tsetse-fly belts, in which neither horse, nor ox, nor dog can exist. If races of these animals were to arise which could withstand the bite of the tsetse-fly, these species might increase more rapidly than the rabbit in Australia has done, nor would it matter if the creatures in question were bright crimson, or any other conspicuous colour.

Take the case of the lion in Africa. The chief bar to the increase in numbers of this species appears to be the teething troubles to which the whelps are liable. Now suppose that a mutation were to occur in the lion. Suppose that several members of a litter were all bright blue, and that these suffered from no teething troubles. They would probably all grow up, and although at some disadvantage as hunters on account of their conspicuous colouring, they would nevertheless probably increase at the expense of the normally coloured lions, because of the immunity of their offspring from death from teething troubles. Zoologists would then be at a loss to explain their bright colouring. We should have all manner of ingenious suggestions raised, namely, that in the

moonlight these creatures were really not at all conspicuous, indeed that they were obliteratively coloured. In other words, a totally wrong explanation of their colouring would be given and accepted. It is our belief that many of the explanations put forward and accepted of the colouration of existing species are wide of the mark.

As all bee-keepers are aware, the disease known as foul-brood works more havoc among their bees than all the insectivorous creatures put together.

Similarly throat disease among wood-pigeons does more towards keeping their numbers down than all the efforts of predacious birds.

A check on multiplication not mentioned by Darwin is that which is sometimes imposed by the individuals of the species on one another. Thus, in some animals, as, for example, the hyæna, the male occasionally devours his own young ones.

A check of a similar nature results from the habit which the Indian House Crow (*Corvus splendens*) has of interrupting the pairing operations of its neighbours.

We are now in a position to sum up briefly the more important requisites for success in the struggle for existence.

These are not so much specialised structure as courage, a good constitution, mental capacity and prolificacy.

Few animals possess all these characteristics in a pre-eminent degree, for, to use the words of Mr Thompson Seton, "Every animal has some strong point or it could not live, and some weak point or the other animals could not live." Courage may be of two kinds—active courage, like that of the Englishman, or passive courage, like that of the Jew.

As D. Dewar has said: In the struggle for existence, "An ounce of good solid pugnacity is worth many pounds of protective colouration."

It is of course possible for an animal to possess too much courage. An excessive amount of courage will often cause a creature to fight unnecessary battles, which may lead to its premature death. This is perhaps the reason why the pugnacious black form of the leopard is not more numerous.

Under a good constitution we must include the power of resisting the rigours of climate, more especially damp, the ability to resist disease, and the enjoyment of a good digestion. When from any cause the normal food of a species becomes scarce, the members of that species will have to starve or supplement the normal diet with food of an unusual nature; and those that are endowed with a good digestion will be able to digest the new food and thus survive, while those which cannot assimilate food

to which they are unaccustomed will become emaciated and perish. We see this in every hard winter in England, when the redwing, which, unlike other thrushes, cannot thrive on berries, is the first to die. Most of the more successful birds—the crows and gulls, for example—are omnivorous—that is to say, they are able to digest all manner of food.

Under mental capacity, we would include cunning and sufficient intelligence to adapt oneself to changed conditions. It is largely through man's superior mental capacity that he has become the dominant species. It is true that he displays also courage and a good constitution, being able to adapt himself to life under the most diverse conditions ; but this is, of course, in part due to his mental capacity, which enables him to some extent to adapt his environment to himself.

The advantages of prolificacy are so apparent that it is unnecessary to dilate upon them. Nearly as important as excessive fertility is the ability on the part of the parents to look after their young ones.

Every successful species possesses in a special degree at least one of the above attributes. It is interesting to take in turn the various species which are most widely distributed and consider to what extent they possess these several qualities.

The Making of Species

Let us now consider a factor in evolution which is nearly as important as natural selection itself—we allude to the phenomenon of correlation.

Correlation

We may define correlation as the inter-dependence of two or more characters. This phenomenon is far more common than the majority of naturalists seem to think. It very frequently happens that one particular character never appears in an organism without being accompanied by some other character which we should not expect to be in any way related to it.

Darwin called attention to this phenomenon. "In monstrosities," he writes, on page 13 of the *Origin of Species* (new edition), "the correlations between quite different parts are very curious, and many interesting instances are given in Isidore Geoffroy St Hilaire's great work on this subject. Breeders believe that long limbs are almost always accompanied by an elongated head. Some instances of correlation are quite whimsical: thus cats which are entirely white and have blue eyes are generally deaf; but it has been lately stated by Mr Tait that this is confined to the males.

"Colour and constitutional peculiarities go together, of which many remarkable cases could be given among animals and plants. From the

facts collected by Heusinger, it appears that white sheep and pigs are injured by certain plants, whilst dark-coloured individuals escape. Professor Wyman has recently communicated to me a good illustration of this fact: on asking some farmers in Virginia how it was that all their pigs were black, they informed him that the pigs ate the paint-root (*Lachnanthes*), which coloured their bones pink, and which caused the hoofs of all but the black varieties to drop off; and one of the 'crackers' (*i.e.* Virginia squatters) added, 'we select the black members of a litter for raising, as they alone have a good chance of living.'

"Hairless dogs have imperfect teeth; long-haired and coarse-haired animals are apt to have, as is asserted, long or many horns; pigeons with feathered feet have skin between their outer toes; pigeons with short beaks have small feet, and those with long beaks large feet.

"Hence, if man goes on selecting, and thus augmenting, any peculiarity, he will almost certainly modify unintentionally other parts of the structure, owing to the mysterious laws of the correlation of growth."

The great importance of the principle of the correlation of organs is, that *natural selection may indirectly cause the survival of unfavourable variations, or of variations which are of no utility to the organism, because they happen to*

be correlated with organs or structures that are useful.

Physiologists insist more and more upon the close interdependence of the various parts of the organism. All recent researches tend to show that each of the organs has, besides its primary function, a number of subordinate duties to perform, and that the removal of one organ reacts on all the others.

In face of these facts we should have expected those zoologists who have followed Darwin to have paid very close attention to the subject of correlation. As a matter of fact, the phenomenon seems to have been almost completely neglected. This is an example of the manner in which the superficial theories which to-day command wide acceptance have tended to bar the way to research.

There seems to be, in the case of some organisms, at any rate, a distinct correlation between their colouring and their constitution or mental characters. For example, the black forms of the cobra, the leopard, and the jaguar are notoriously bad-tempered.

"There is," writes Col. Cunningham, on p. 344 of *Some Indian Friends and Acquaintances*, "much variation in the temper of different varieties of cobras, and, as is often so noticeable among other sorts of animals, there would seem to be a distinct correlation between darkness of

colour and badness of temper. It is probably in part owing to a recognition of this that the cobras ordinarily seen in the hands of the so-called snake charmers are of a very light colour, although the choice may also be to some extent of æsthetic origin, seeing that the paler varieties are specially ornamental, due to the brilliancy of their markings and the great development of their hoods." It would thus appear that there is also a correlation between the colour of the cobra and the size of its hood.

Hesketh Pritchard informs us, in *Through the Heart of Patagonia*, that the Gauchos assert that a "picaso" colt—that is to say, a black one with white points—is the reverse of docile. Similarly, black mice are said to be very hard to tame.

We have already called attention to the importance of courage and the power of resisting the rigours of climate in the struggle for existence. It is apparently because black is so frequently correlated with courage that it is seen comparatively often in nature, in spite of the fact that it is a very bad colour as regards protection from enemies. Those birds and beasts which are black are usually thriving species. The dominance of the crow tribe is a case in point. Crows, it is true, are not really courageous, but they are dangerous owing to their gregarious habits, and are dreaded by other creatures on account of their power of combination. In *Birds of the*

Plains, D. Dewar records an instance of a number of crows killing in revenge so powerful a bird as the kite.

Since very many species seem to throw off melanistic variations, it may perhaps be asked, How is it that more black species do not exist?

The reply is twofold. In the first place, it is quite likely that in some organisms black variations are not correlated with courage or extreme pugnacity, and when such is the case the melanistic varieties will be more likely to be exterminated by foes, on account of their conspicuousness. It must be remembered that, other things being equal, the inconspicuously coloured organism has a better chance of survival than the showily coloured one. This is, of course, a very different attitude from that which insists on the all-importance to animals of protective colouration. Secondly, it is not difficult to see how too much courage may be fatal to an animal in leading it to take risks which a more timid creature would refrain from doing. This, as we have already suggested, is probably the reason why the black panther is so scarce. The black colour is readily inherited, so there must be some cause which tends to kill off the black varieties of the panther.

Lest it be thought the idea that excessive courage and pugnacity are harmful is mere fancy, let us quote from the account of the nesting

habits of the White-rumped Swallow (*Tachycineta leucorrhoa*) given by Mr W. H. Hudson on p. 32 of *Argentine Ornithology*. He says that no matter how many nesting sites are available, there is always much fighting amongst these birds for the best places. "Most vindictively," he writes, "do the little things clutch each other, and fall to the earth twenty times an hour, where they often remain struggling for a long time, heedless of the screams of alarm their fellows set up above them; for often, while they thus lie on the ground punishing each other, they fall an easy prey to some wily pussy who has made herself acquainted with their habits."

We have already emphasised the importance to many species of possessing the power of resisting the effects of damp. In the case of some organisms favourable variations in this direction may possess a greater survival value than those in the shape of greater speed or physical strength.

Now, if there be any correlation between the power of resisting damp and the colour an animal bears, it is quite probable that animals of this colour, whether or no it be conspicuous, are likely to survive in preference to those who are more protectively coloured. There is some evidence that in certain cases, at any rate, resistance to climate is correlated with colour peculiarities. For example, some fanciers assert that yellow-legged poultry resist cold and damp better than

those whose legs are not yellow. Fowls which have yellow legs have also yellow skins. In this connection the almost universal assumption of orange feet by domestic guinea-fowls is significant. Normally the feet of these birds are black, and their natural African habitat is a dry one.

A grey or white colour appears to be correlated with resistance to cold. In birds this may perhaps be explained by the fact that the feathers in some light-coloured varieties are longer than in those of normally-coloured ones. Thus mealy-coloured canaries have longer feathers than brightly-coloured ones.

The Arctic Skua, having no enemies to fear, stands in no need of protective colouration. It would therefore seem that the white-breasted form of this bird becomes more numerous as it nears the north pole, not because of the closer assimilation of its plumage to the colour of the snowy surroundings, but because the bird has to resist the greater degree of cold the farther north it finds itself. Similarly, in the region of the south pole the albino form of the Giant Petrel (*Ossifraga gigantea*) becomes common. Both these birds are themselves predatory and not liable to be preyed upon.

The curious china-white legs of some desert birds—as, for example, coursers and larks—would seem to indicate a power of resisting the hot rays

radiating from the sand on which these creatures dwell.

White quills do not wear well either in domestic birds or in wild albinos. This may explain why it is that when a white wild species of bird has any black in its plumage the black is almost invariably on the tips of the wings.

White quill-feathers are one of the commonest variations observed in domesticated birds, nevertheless they are as rare as complete whiteness among birds in their natural state.

A chestnut or bay colour in mammals appears to be correlated with a high rate of speed, as in the thoroughbred horse. This perhaps explains why so many of the swiftest species of antelope, such as the hartebeests and sassaby (*Damaliscus lunatus*), are chestnut bay in colour. It is further a remarkable fact that in the Black-buck (*Antilope cervicapra*) and the Nilgai (*Boselaphus tragocamelus*) the females, which are faster than the males, are not black or grey like their respective males, but reddish.

Wild turkeys are bronze; tame ones are black more often than any other colour. This may be due to the fact that in them nigritude is correlated with the power to resist damp. Among human beings those races which live in very swampy districts are often intensely black.

It is a significant fact that those domestic animals which are bred for speed or for fighting

purposes do not assume all the varied hues that characterise those that are allowed to breed indiscriminately. Racehorses, greyhounds, and homing pigeons furnish examples of this. Even more remarkable is the case of the Indian Aseel or game-cock. This is bred purely for fighting purposes, and is required to display extraordinary powers of endurance, since the spurs are cut off in order to prolong the fight. Thus it is that this Indian race of game-cocks shows little variation when compared with the English breed, which fights in a more natural manner. The hens of the Indian form seem never to show the colouration of the wild jungle fowl, although the cocks may do so. It would appear that hens having the colouration of their wild ancestors cannot breed cocks possessed of the requisite courage. The Aseel is said to be of the highest courage only when the legs, beak and iris are white.

There is, we believe, not the least doubt that many other connections between colour and various characteristics have yet to be discovered. It is high time that competent naturalists paid attention to this subject. A study of the question will almost certainly throw much light upon many phenomena of animal colouration which hitherto have not been satisfactorily explained. It is quite likely that the sandy hue displayed by birds and beasts which frequent desert regions

may be due to a correlation with the power of withstanding intense dry heat rather than to its rendering them inconspicuous to their foes.

As other examples of correlation we may cite the correlation which seems to obtain between short canine teeth and the absence of a hairy covering to the body. This phenomenon is observed both in men and pigs. Hairless dogs almost invariably have their teeth but poorly developed.

Darwin called attention to the connection between a short beak and small feet in pigeons; we see the same phenomenon in the dwarf breed of ducks known as call-ducks.

A curious correlation exists between fowls' eggs with brown shells and the incubating habit. Fanciers have long tried in vain to produce a hen that lays brown eggs without becoming "broody" at certain seasons.

Among fowls, long legs are invariably correlated with a short tail, as is well seen in the Malay breed. This correlation may explain the short tails of wading birds. Short-legged fowls, like Japanese bantams, have long tails, and it is significant that the short-legged Weka Rails (*Ocydromus*) of New Zealand have unusually long tails for the family. In this connection we may say that the tail-like plumes of the cranes are not tail-feathers, but the tertiary feathers of the wings. As egrets also have long trains of

plumes growing from the back, it cannot be said that the short tail of the vast majority of the waders is due to the fact that these birds would be at a disadvantage were their caudal feathers long.

Isolation

Isolation is a most important factor in the making of species. It is a factor to which Darwin failed to attach sufficient importance, and one which has been to a large extent neglected by Wallaceians.

We have seen how a species can be improved or changed by natural selection. All those individuals which have varied in a favourable direction have been preserved, and allowed to leave behind them offspring that inherit their peculiarities, while those which have not so varied have perished without leaving behind any descendants. Thus the nature of the species has changed. The old type has given place to a new one. Instead of species A, species B exists. This is what Romanes has called *monotypic* evolution—the transformation of one species into another species. But any theory of the origin of species must be able to answer the question, Why have species multiplied? How is it that species A has given rise to species B, C, and D, or, while itself continuing to exist, has thrown off sister species B and C? How is it

that in the course of evolution, species have not been transmuted in linear series instead of ramifying into branches? This ramification of a species into branches has been termed by Romanes *polytypic* evolution. It is easy to see how natural selection can bring about monotypic evolution, but how can it have effected polytypic evolution? To use Darwin's phraseology, how is it that divergence of character has come about? Darwin's reply to this question is (*Origin of Species*, p. 136), "from the simple circumstance that the more diversified the descendants from any one species become in structure, constitution, and habits, by so much will they be better enabled to seize on many and widely diversified places in the polity of nature, and so be enabled to increase in numbers.

"We can clearly discern this in the case of animals with simple habits. Take the case of a carnivorous quadruped, of which the number that can be supported in any country has long ago arrived at its full average. If its natural power of increase be allowed to act, it can succeed in increasing (the country not undergoing any change in its conditions) only by its varying descendants seizing on places at present occupied by other animals: some of them, for instance, being enabled to feed on new kinds of prey, either dead or alive; some inhabiting new stations, climbing trees, frequenting water, and

some perhaps becoming less carnivorous. The more diversified in habits and structure the descendants of our carnivorous animal become, the more places they will be enabled to occupy. What applies to one animal will apply throughout all time to all animals—that is, if they vary—for otherwise natural selection can effect nothing." Darwin was, therefore, of opinion that natural selection is able to bring about polytypic evolution. Darwin tacitly assumes, in the illustration he gives, that the various races of the carnivorous animal are in some way prevented from intercrossing; for if they interbreed indiscriminately, these races will tend to be obliterated.

"That perfectly free intercrossing," writes Professor Lloyd Morgan (on p. 98 of *Animal Life and Intelligence*), "between any or all of the individuals of a given group of animals is, so long as the characters of the parents are blended in the offspring, fatal to divergence of character, is undeniable. Through the elimination of less favourable variations, the swiftness, strength, and cunning of a race may be gradually improved. But no form of elimination can possibly differentiate the group into swift, strong, and cunning varieties, distinct from each other, so long as all three varieties freely interbreed, and the characters of the parents blend with the offspring. Elimination may and does give rise to progress in any given group, *as a group*; it

does not and cannot give rise to differentiation and divergence, so long as interbreeding with consequent interblending of characters be freely permitted. Whence it inevitably follows, as a matter of simple logic, that where divergence has occurred, intercrossing and interbreeding must in some way have been lessened or prevented.

Thus a new factor is introduced, that of *isolation* or *segregation.* And there is no questioning the fact that it is of great importance, Its importance, indeed, can only be denied by denying the swamping effects of intercrossing, and such denial implies the tacit assumption that interbreeding and interblending are held in check by some form of segregation. The isolation explicitly denied is implicitly assumed."

This is very sound criticism, and is not very materially affected by the fact that the intercrossing of varieties does not necessarily imply a blending of their characters in the offspring; for, as we have seen, some characters do not blend. No matter what form inheritance takes, in order that natural selection may cause polytypic evolution it must be assisted by isolation in some form or other.

Thus isolation is an important factor in evolution, though probably not so important as its more extreme advocates would have us believe. Wagner, Romanes, and Gulick have, in insisting

upon the importance of the principle of isolation, rendered valuable service to biological science, but, in common with most men having a new theory, they have pushed their conclusions to absurd lengths.

As Romanes has pointed out, isolation may be discriminate or indiscriminate. "If," he writes, on p. 5 of vol. iii. of *Darwin and after Darwin*, "a shepherd divides a flock of sheep without regard to their characters, he is isolating one section from the other indiscriminately; but if he places all the white sheep in one field, and all the black sheep in another field, he is isolating one section from the other discriminately. Or, if geological subsidence divides a species into two parts, the isolation will be indiscriminate; but if the separation be due to one of the sections developing, for example, a change of instinct determining migration to another area, or occupation of a different habitat on the same area, then the isolation will be discriminate, so far as the resemblance of instinct is concerned."

Other names for indiscriminate isolation are separate breeding and apogamy. Discriminate isolation is also called segregate breeding and homogamy. The human breeder resorts to discriminate isolation in that he separates all those creatures from which he seeks to breed, from those from which he does not wish to breed. Natural selection itself is, therefore, a

kind of discriminate isolator, since it isolates the fit by destroying all the unfit, and, inasmuch as it kills off all those creatures which it fails to isolate, it differs from other forms of isolation in preventing the inter-breeding of the unisolated forms and their giving rise to a different race. Thus it is clear that natural selection, unless aided by some other form of isolation, can give effect to only monotypic evolution. This is a point on which Romanes rightly insists strongly.

There are several other forms of discriminate isolation. Sexual selection would be one of these. Suppose, for example, that in any species there are large and small varieties formed, and like tends to breed with like, then the small individuals will breed with other small individuals, while large ones will mate with large ones; thus two races—a large one and a small one—will be evolved side by side, provided, of course, natural selection does not step in and destroy one of them.

Another kind of discriminate isolation may be due to the fact that one variety is ready to pair before the other; thus two races are likely to arise which breed at different seasons. It is unnecessary for us to discourse further on the subject of discriminate isolation; those interested in the subject should read vol. iii. of *Darwin and after Darwin*, by Romanes.

It is impossible to deny the importance of

discriminate isolation as a factor in evolution. On this there can be no room for disagreement among biologists. It is when we come to the subject of indiscriminate isolation that we enter a region of zoological strife.

Is indiscriminate isolation *per se* a factor of evolution? Romanes, Gulick, and Wagner assert that it is, Wallace and his adherents assert that it is not.

As the burden of proof is on the former, they are entitled to the first hearing.

"We may well be disposed, at first sight," writes Romanes (*Darwin and after Darwin*, p. 10), "to conclude that this kind of isolation can count for nothing in the process of evolution. For if the fundamental importance of isolation in the production of organic forms be due to its segregation of like with like, does it not follow that any form of isolation which is indiscriminate must fail to supply the very condition on which all the forms of discriminate isolation depend for their efficacy in the causing of organic evolution? Or, to return to one's concrete example, is it not self-evident that the farmer who separated his flock into two or more parts indiscriminately, would not effect any more change in his stock than if he had left them all to breed together? Well, although at first sight this seems self-evident, it is, in fact, untrue. For, unless the individuals which are indiscriminately isolated

happen to be a very large number, sooner or later their progeny will come to differ from that of the parent type, or unisolated portion of the parent stock. And, of course, as soon as this change of type begins, the isolation ceases to be indiscriminate; the previous apogamy has been converted into homogamy, with the usual result of causing a divergence of type. The reason why progeny of an indiscriminately isolated section of an originally uniform stock—*e.g.* of a species—will eventually deviate from the original type is, to quote Mr Gulick, as follows:—'No two portions of a species possess exactly the same average character, and the initial differences are for ever reacting on the environment and on each other, in such a way as to ensure increasing divergence as long as the individuals of the two groups are kept from intergenerating.'"

The words of Mr Gulick require close scrutiny. We may admit that "no two portions of a species possess exactly the same average character," but why should the two, if prevented from interbreeding yet subjected to similar climatic and other conditions, present the phenomenon of "increasing divergence?" The reason assigned by Romanes is the "Law" of Delbœuf, which runs:—"*A constant cause of variation*, however insignificant it may be, changes the uniformity of type little by little, and diversifies it *ad in-*

finitum." From this "Law" it follows, says Romanes, on p. 13 of vol. iii. *Darwin and after Darwin*, that "no matter how infinitesimally small the difference may be between the average qualities of an isolated section of a species compared with the average qualities of the rest of that species, if the isolation continues sufficiently long, differentiation of specific type is necessarily bound to ensue."

This deduction involves two important assumptions. The first is, that in each of the separated portions of the given species there is a constant cause of variation operating in one direction in the case of one portion and in another direction in the case of the other. This assumption is, unfortunately, not founded on fact. If we were to take one hundred race-horses and shut them up in one park and one hundred cart-horses and shut them up in another park, and prevent the interbreeding of the two stocks, we should, if Romanes's tacit assumption be true, see the two types diverge more and more from one another. We know that as a matter of fact they will tend, generation after generation, to become more like one another. Galton's Law of Regression, of which we have already spoken, and which is supported by ample evidence, clearly negatives this tacit assumption made by Romanes and Gulick. The second assumption upon which their reasoning is based is that there is no limit

to the amount of change which can be effected by the accumulation of fluctuating variations; but, as we have already seen (on p. 70), there is a very definite limit and this limit is quickly reached.

Thus the arguments of Romanes and Gulick are fundamentally unsound.

But the fact remains, and has to be accounted for, that, as a general rule, when two portions of a species are separated, so that they are prevented from interbreeding, they begin to diverge in character, and the longer they remain thus separated the greater becomes that divergence. This is an observed fact which cannot be gainsaid.

It was the observance of this fact which led Gulick to insist with such emphasis on the importance of geographical isolation as a factor in evolution. He discovered that the land mollusca of the Sandwich Islands fall into a great number of varieties.

These islands are very hilly, and Gulick found that each of the varieties is confined not merely to one island, but to one valley. "Moreover," writes Romanes, on p. 16 of *Darwin and after Darwin*, "on tracing this fauna from valley to valley, it is apparent that a slight variation in the occupants of valley 2, as compared with those of the adjacent valley 1, becomes more pronounced in the next, valley 3,

still more so in 4, etc., etc. Thus it was possible, as Mr Gulick says, roughly to estimate the amount of divergence between the occupants of any two given valleys by measuring the number of miles between them. . . . The variations which affect scores of species, and themselves eventually run into fully specific distinctions, are all more or less finely graduated as they pass from one isolated region to the next; and they have reference to changes of form or colour, which in no one case presents any appearance of utility."

Hitherto three different attempts have been made to explain this and allied phenomena :—

1. That it is the result of isolation.
2. That it is the result of natural selection.
3. That it is the result of the action of the environment on the organism.

Let us consider these in inverse order.

In the case of some organisms, more especially plants, invertebrates, and fish, the environment does exert a direct influence on their colouration. But, as we have seen, the changes in colour, etc., thus induced appear never to be transmitted to the offspring of the organisms so affected. They disappear when the offspring are removed to other surroundings.

On the other hand, local races or species—as, for example, the white-cheeked variety of sparrow found in India—usually retain their

external appearance when the environment is changed. In the one case the peculiarity is not inherited; in the other it is inherited.

The Wallaceian explanation is, of course, that the phenomenon is the result of natural selection. There must, say Wallace and his followers, be some differences in the environment, differences which we poor human beings cannot perceive, that have caused the divergence between the various isolated sections of the species. In the case of some local species this explanation is probably the correct one, but we have no hesitation in saying that natural selection is unable to offer a satisfactory explanation in a considerable number of instances. Take, for example, the case of the land mollusca of the Sandwich Islands. Mr Gulick worked for fifteen years at them, and states that so far as he is able to ascertain the environment in the fifteen valleys is essentially the same. "To argue," writes Romanes, on p. 17 of vol. iii. of *Darwin and after Darwin*, "that every one of some twenty contiguous valleys in the area of the same small island must necessarily present such differences of environment that all the shells in each are differently modified thereby, while in no one out of the hundreds of cases of modification in minute respects of form and colour can any human being suggest an adaptive reason therefor —to argue thus is merely to affirm an intrinsic-

ally improbable dogma in the presence of a great and consistent array of opposing facts."

Men of science not infrequently charge the clergy with adhering to dogma in face of opposing facts; it seems to us that many of the apostles of science are in this respect worse offenders than the most orthodox of Churchmen.

The example of the mollusca of the Sandwich Islands is by no means a solitary one. D. Dewar cited some interesting cases in a paper recently read before the Royal Society of Arts (p. 103 of vol. lvii. of the Society's Journal):

"The Indian robins present even greater difficulties to those who profess to pin their faith to the all-sufficiency of natural selection. Robins are found in nearly all parts of India, and fall into two species, the brown-backed (*Thamnobia cambaiensis*) and the black-backed Indian Robin (*Thamnobia fulicata*). The former occurs only in Northern India, and the latter is confined to the southern portion of the peninsula. The hen of each species is a sandy brown bird with a patch of brick-red feathers under the tail, so that we cannot tell by merely looking at a hen to which of the two species she belongs. The cock of the South Indian form is, in winter, a glossy black bird, with a white bar in the wing, and the characteristic red patch under the tail. The cock of the northern species, as his name implies, has a sandy-brown back, which contrasts

strongly with the glossy black of his head, neck, and under parts. In summer the cocks of the two species grow more like one another owing to the wearing away of the outer edges of their feathers ; but it is always possible to distinguish between them at a glance. The two species meet at about the latitude of Bombay. Oates states that in a certain zone, from Ahmednagar to the mouth of the Godaveri valley, both species occur, and they do not appear to interbreed.

It seems impossible to maintain that natural selection, acting on minute variations, has brought about the divergence between these two species. Even if it be asserted that the difference in the colour of the feathers of the back of the two cocks is in some way correlated with adaptability to their particular environment, how are we to explain the fact that in a certain zone both species flourish ?

" A similar phenomenon is furnished by the red-vented bulbul. This genus falls into several species, each corresponding to a definite locality and differing only in details from the allied species, as, for example, the distance down the neck to which the black of the head extends. There is a Punjab Red-vented Bulbul (*Molpastes intermedius*), a Bengal (*Molpastes bengalensis*), a Burmese (*Molpastes burmanicus*), and a Madras (*Molpastes hæmorrhous*) species.

"It does not seem possible to maintain the contention that these various species are the products of natural selection, for that would mean if the black of the head of the Punjab species extended further into the neck the bird could not live in that country."

Thus, natural selection clearly is unable to explain some cases of divergence of character due to geographical isolation.

There remains the third explanation, that the divergence is the result of the simple fact of isolation.

We have already shown how insuperable are the objections to the view held by Romanes and Gulick.

It seems to us that explanation must lie in the fact that mutations occur every now and again in some species. If two portions of a species are separated and a mutation occurs in one portion and not in the other, and if the mutating form succeeds in supplanting the parent form in that isolated portion of the species in which it has appeared, we should have the phenomenon of two races or species differing in appearance although subjected to what appear to be identical environment.

This, of course, is pure conjecture. All that can be said of it at present is that it is not opposed to observed facts. That mutations do occur must be admitted. At present we are

totally in the dark as to what causes them. They arise at the most unexpected times.

In favour of the explanation based on "mutation" there is the interesting fact that geographical isolation does not by any means always cause divergence of character. This Romanes, with great fairness, freely admits. "There are," he writes, on p. 133 of vol. iii. of *Darwin and after Darwin*, "four species of butterflies, belonging to three genera (*Lycæna donzelii*, *L. pheretes*, *Argynnis pales*, *Erebia manto*), which are identical in the polar regions and the Alps, notwithstanding that the sparse Alpine populations have been presumably separated from their parent stocks since the glacial period." Again, there are "certain species of fresh-water crustaceans (*Apus*), the representatives of which are compelled habitually to form small isolated colonies in widely separated ponds, and nevertheless exhibit no divergence of character, although apogamy has probably lasted for centuries."

To these examples we may add that of the cormorants. These birds have an almost world-wide range. One species — our Cormorant (*Phalacrocorax carbo*)—occurs in every imaginable kind of environment. Isolation has not effected any changes in the appearance of this species. Yet in New Zealand there exist no fewer than fourteen other species of cormorant. New Zealand is a country where climatic con-

ditions are comparatively uniform, nevertheless it boasts of no fewer than fifteen out of the thirty-seven known species of cormorant. A possible explanation of this phenomenon may be found in the comparatively easy conditions under which cormorants live in New Zealand.[1] Under such circumstances mutants may be permitted by natural selection to survive, whereas in other parts of the world such mutants have not been able to hold their own.

Prof. Bateson has likened natural selection to a competitive examination to which every organism must submit. The penalty for failure is immediate death. The standard of the examination may vary with the locality.

Isolation, then, is a very important factor in the making of species, for without it, in some form, the multiplication of species is impossible.

Let us, in conclusion, briefly summarise what we now know of the method in which new species are made. We have studied the various factors of evolution—variation and correlation, heredity, natural selection, sexual selection, and the other kinds of isolation. How do these combine to bring new species into being, and to establish the same?

Let us first consider the factor known as natural selection, since this is the one on which

[1] Hutton and Drummond record other examples of this in the valuable work entitled *The Animals of New Zealand.*

Darwin laid such great stress. Natural selection, although a most important factor in evolution, is not an indispensable one. Evolution is possible without natural selection.

Let us suppose that there is no such thing as natural selection; that the numbers of existing species are kept constant by the elimination of all individuals born in excess of the number required to maintain the species at the existing figure, and that the elimination of the surplus is effected, not by natural selection, but by chance, by the drawing of lots. Under such circumstances there may be evolution, existing species may undergo change, but the evolution will be determined solely by the lines along which variations occur.

If mutations take place along certain fixed lines, and tend to accumulate in the given directions, evolution will proceed along these lines quite independently of the utility to the organism of the mutations that occur. An unfavourable mutation will have precisely the same chance of survival as a favourable one.

If, on the other hand, mutations occur indiscriminately on all sides of the mean, then those mutations which happen to occur most frequently will have the best chance of survival, and they will mark the lines of evolution. But suppose that no mutation occurs more frequently than the others. Under such circumstances there

will be no evolution, unless, by some cause or other, portions of the species are isolated, because in the long run the mutations will neutralise one another.

Let us now suppose that natural selection comes into play. The old method of determining by lot which forms shall persist is replaced by selection on the fixed principle that the fittest shall survive. The mutations appear as before, and as before, of the large number that occur, only a few are permitted to survive. But now the survivors, instead of being a motley crowd, are a selected band, composed of individuals having many characteristics in common — a homogeneous company. Thus one result of natural selection is to accelerate evolution, by weeding out certain classes of individuals and preventing them breeding with those it has selected. On the other hand, natural selection will tend to diminish the number of species which have arisen through mutation, inasmuch as it weeds out many mutants which would have perished had their survival been determined by lot.

From this the kind of work performed by natural selection should be obvious. Natural selection does not make new species. These make themselves, or, rather, originate in accordance with the laws of variation.

"You can," runs an old proverb, "bring a

horse to the drinking fountain, but you cannot make him drink." You may be able to bring a child into the world, but you cannot secure its survival. Variation brings into being mutants, which are incipient species, but variation cannot determine their survival. It is at this stage that natural selection steps in.

But because natural selection allows certain mutations to persist, it is not correct to say that natural selection has caused these mutations or made or originated the species to which they give rise.

The Civil Service Commissioners do not make Indian civil servants: they merely determine which of a number of ready-made men shall become civil servants. Similarly, natural selection does not make new species, it simply decides which of a number of ready-made organisms shall survive and establish themselves as new species. Nor does natural selection always do as much as this; for it is not the only determinant of survival. Its position is sometimes comparable to that of the Medical Board which inspects and rejects the physically unfit of the candidates which have already been selected by some other authority.

The examination conducted by natural selection may be compared to a competitive one. A separate, independent examination is held for each particular locality; consequently the severity of the competition will vary with the locality.

In each competition some candidates pass with ease: they gain an unnecessarily high total of marks. So in nature do certain organisms, as, for example, the Leaf-butterflies (*Kallimas*), appear to be over-adapted to their environment. Other candidates manage to pass only by a very narrow margin: these are paralleled in nature by those species which are barely able to maintain themselves, which become extinct the moment the competition increases in severity.

The great bulk of the candidates fail to obtain sufficient marks to gain a place among the chosen few; these unsuccessful candidates correspond to the mutating forms which perish in the struggle for existence, to those individuals which happen to have mutated in unfavourable directions.

Even as many candidates have acquired knowledge of subjects in which they are not examined, so do many organisms possess characteristics which are of no utility to them in the struggle for existence.

Wallaceians expend much time and energy in misguided attempts to explain the existence of such characters in terms of natural selection.

Nature's examination, like that held for entrance to the Indian Civil Service, is a liberal one, so that the qualifications of the successful candidates vary considerably. Provided a candidate is able to gain more marks than the other candidates for a vacancy, it matters not in what

subjects the marks are gained. So is it in nature. Natural selection takes an organism as a whole. One species may have established itself because of its fleetness, a second because of its courage, a third because it has a strong constitution, a fourth because it is protectively coloured, a fifth because it has good digestive powers, and so on.

We thus perceive the part played by natural selection and other forms of isolation in the making of species. It is obvious that these do not make species any more than the Civil Service Commissioners manufacture Indian civil servants.

The real makers of species are the inherent properties of protoplasm and the laws of variation and heredity. These determine the nature of the organism ; natural selection and the like factors merely decide for each particular organism whether it shall survive and give rise to a species.

The way in which natural selection does its work is comparatively easy to understand. But this is only the fringe of the territory which we call evolution.

We seem to be tolerably near a solution of the problem of the causes of the *survival* of any particular mutation. This, however, is merely a side issue. The real problem is the cause of variations and mutations, or, in other words, how species *originate*. At present our knowledge of the causes of variation and muta-

tion is practically *nil.* We do not even know along what particular lines mutations occur.

We have yet to discover whether one mutation invariably leads to another along the same lines —in other words, whether mutating organisms behave as though they had behind them a force acting in a definite direction. The solution of these problems seems afar off. The hope of solving them lies, not in the speculations in which biologists of to-day are so fond of indulging, but in observation and experiment, especially the last.

The future of biology is largely in the hands of the practical breeder.

INDEX

ACCENTOR, 1
Accipiter cooperi, 243
Acorn, 49
Acquired characters, 10, 14, 15, 18-24, 60, 107-10
Acræidæ, 175, 215, 228
Ægilops speltæformis, 118
Ægithina tiphia, 244
Æsthetic sense in birds, 306
"African Nature Notes and Reminiscences," 192, 195, 199
Aggressive resemblance, 173
Aguara-guazu, 181
Aitken, E. H., 64
"Albany Review, The," 43, 48, 195, 204
Albinism, 64, 65, 99, 283, 284, 362
Alcedo ispida, 289
Alcock, Col., 216, 217
Alcohol, 152, 153
Alexander, 181
Allen, Grant, 66
Allotrophy, 159
Alternating characters, 143
Alternative inheritance, 127
Amadavat, 311
Amandina erythrocephala, 122
A. fasciata, 122
"Amazement," 93
Amazon parrot, 103
Amazonian dolphin, 99
Ammonites, 67
Ammonium sulphate, 151
Amœba, 35
Amphidasys betularia, 101
Anas boscas, 123, 334
A. obscura, 334
A. pœcilorhyncha, 315, 334
A. superciliosa, 315, 334
A. undulata, 334
Anastomus oscitans, 282
Ancon sheep, 95
Anemone magellanica, 118
A. sylvestris, 118
Anemophilous flowers, 261
"Animal Colouration," 194, 205, 211, 213, 218, 222
"Animal Life and Intelligence," 368
"Animals of New Zealand," 382
Anous, 278
Anser cygnoides, 114
Anseranas melanoleucus, 281
Antarctic fauna, 191
Antelope, 48, 199, 334
Anthracoceros, 220
Anthropoides paradisea, 279
A. virgo, 279
Antilope cervicapra, 363
Ape, 101
Apogamy, 370
Appenzeller, 340
Apus, 381
"Archiv für Entwicklungsmechanik der Organismen," 325, 330
Arctic fauna, 173, 174, 190, 191
Arctic regions, 173, 189
Ardea asha, 317, 318
A. gularis, 318
Ardeola grayii, 250, 254
Argali, 120, 130, 131
"Argentine Ornithology," 361
Argynnis pales, 381
A. paphia, 103
Aristotle, 1
Artemia milhausenii, 156
A. salina, 156
Aseel, 364
Asexual reproduction, 135
Asiatic, 140
Ass, 117, 127, 128, 140
Astur badius, 235
Atavism, 136, 293
Athene chiaradiæ, 97
A. noctua, 97
Atoms, biological, 158
"Auk, The," 190
Aularches militaris, 216
Avebury, Lord, 205, 260
"Avicultural Magazine, The," 98
Avocet, 80

BABBLER, 244
Bactrian camel, 121
Bailey, 88
Baillon's crake, 251
Balanced characters, 143

Balearica chrysopelargus, 105
B. regulorum, 105
Bassaris astuta, 242
Batesian mimicry, 177
Bateson, 26, 72, 73, 74, 75, 76, 102, 103, 302
Bats, 42
Bear, 101, 119, 190, 216, 282
Beddard, 180, 188, 194, 205, 211
Bee, 178, 179, 214, 221, 263, 264, 269
Beech, purple, 87
Bee-eater, 220, 278
Beetroots, 71
Belt, 216
Beluga, 190
Bentham, 260
Bestiary, 125
Bicheno's finch, 105
Bilateral symmetry, 252, 253, 257
Bingham, Col. C. T., 239
Biological atoms, 158-69, 280
Biological molecules, 157-69, 280, 285, 291, 293, 294, 295, 344
Biological radicles, 158-69
Biophors, 153
"Bird Book, the," 207
"Birds of the Plains," 233, 303, 309, 359
Bison, 119, 126
Blackcock, 129, 131, 249, 278
Blackberry, 118
Blackbird, 201, 203, 207
Black-buck, 363
Blakiston, 181
Bloodsucker, 220
Blue-bellied waxbill, 104
Blyth, 115, 251
Boisier, 263
Bombyx arrindia, 125
B. cynthia, 124
Bonhote, 126, 288, 289, 290, 291, 292, 293, 337
Bontebock, 196
Boselaphus tragocamelus, 357, 363
Bos frontalis, 126
Boulenger, 88
Bower-bird, 306
Brain-fever bird, 235, 236, 248
Bramble, 261
Branchipus, 156
Brannam, 92
Brent, Mr, 307
British Museum, 129, 130, 187
Bubo virginianus, 221
Bubulcus coromandus, 254
Budgerigars, 101
Buffalo, 120, 199
Buffon, 2
Buff Orpingtons, 65
Buff-tip moth, 215
Bufo melanostictus, 219
Bulbul, 123, 220, 221, 244, 245, 255, 256, 279
Bull, 119
Bungarus cæruleus, 217, 247
Bunting, reed, 98, 190, 289
Buphus coromandus, 317, 318
Burbank, 118
Burnet moth, 102
Bush-buck, 196
Butcher-bird, 241, 253
Buttercups, 70, 267, 274
Butterfly, 45, 47, 102, 103, 196, 197, 203, 204, 209, 212, 216, 238, 239, 240, 250, 264, 280, 306, 381
Buzzard, 262

CACOMISTLE, 242
Cairina moschata, 127, 245
Californian currant, 119
Calœnas nicobarica, 65
Calotes versicolor, 220
Camel, 120, 357
Campophaga, 248
Canary, 100, 101, 102, 117, 120, 127, 280, 338, 362
Canis jubatus, 181
Capercailzie, 129, 131
Capuchin monkey, 216
Carbon, 153
Carduelis caniceps, 255
C. carduelis, 255
Carnation, 85, 86
Carnivores, 67
Carp, 102
Carrion crow, 123
Carrot, 71, 269, 270
Casarca cana, 129
C. tadornoides, 129
"Cassell's Book of the Horse," 69
Castle, 149
Castration, effects of, 335, 344
Cat, 61, 98, 99, 100, 206, 282, 283, 339, 350, 356, 361
Cat-rabbit, 125

Index

Cataloe, 119
Cataract, 340
Caterpillars, 155, 175, 205, 211, 215, 221, 350
Cattle, 94, 95, 115
Centropus sinensis, 220, 244
Cephalophus doriæ, 243
Cephalopyrus flammiceps, 244
Cervulus muntjac, 101
C. reevesii, 114
C. vaginalis, 114
Cervus paludosus, 180
C. sika, 120
Ceryle rudis, 202
Chaffinch, 289
Chamba monaul, 104
"Champion Ladybird," 91, 92, 93
Change of function, theory of, 36, 37
Chen nivalis, 282
C. rossi, 282
Chenatopex ægyptiaca, 316
Chenonetta jubata, 316
Chinese goose, 99, 114, 121, 130
Chinese pheasant, 123
Chloëphaga dispar, 105
C. magellanica, 105, 334
C. rubidiceps, 105, 334
Chromosomes, 145-7
Chrysæna victor, 333
Chrysolophus amherstiæ, 121
C. obscurus, 97
C. pictus, 97, 121, 337
Chrysomitris colombiana, 244
Chrysotis æstiva, 103
Ciconia alba, 282
C. boyciana, 282
Cinnabar moth, 227
Cissopis leveriana, 281
Civil Service Commissioners, 385, 387
Cleistogamous flowers, 260
Climate as check on multiplication, 349, 350
Clouded-yellow butterfly, 103
Clover, 69, 274
Clytus arietis, 178, 229
Cobra, 224, 225, 226, 358, 359
Colias edusa, 103
Colour-blindness, 340
Colouration of Flowers, Law of Progressive, 66
—— of Organisms, 170-296
Columbidæ, 331, 333
Concealing colouration, 184-7
Congenital characters, 18, 19
Conn, 47
"Contemporary Review," 26
Cope, 15, 67
Copsychus saularis, 281
Coracias affinis, 123, 255
C. indica, 123, 220, 255
Cordon-bleu, 104
Cormorant, 190, 191, 277, 381, 382
Corn, Indian, 81
Correlation, 39, 40, 117, 162, 167, 223, 339, 340, 344, 356-65
Corvus corone, 123, 255
C. cornix, 123, 255
C. splendens, 353
"Country-Side, The," 261, 265, 266, 273, 304, 311, 313
Courser, 362
Court-bec, 72
Cow, 119, 120, 126
Crab, 155
Crane, 105, 247, 248, 279, 282, 292
Crateropus bicolor, 242
C. canorus, 179
Crax globicera, 104, 304
C. grayi, 104
C. hecki, 104, 304
Crested newt, 124
Cretaceous reptiles, 67
Crinoids, 67
Crocodile, 187
Cross-fertilisation, 69, 258-60
Crotalus, 223
Crow, 47, 123, 206, 220, 247, 255, 281, 353, 355, 359, 361
"Crow-pheasant," 220
Cryptic colouring, 173
Cuckoo, 220, 233, 235, 236, 243, 244, 247, 248, 289
—— shrike, 248
Cuculus canorus, 289
Cuénot, 149
Cunningham, Col., 225, 226, 358
—— J. T., 15, 19, 20, 324, 325, 329, 331, 332, 333, 336
Cupples, Mr, 308
Curassow, 104, 304
Currant, 119
Cut-throat finch, 122
Cypselus affinis, 243
Cytisus adami, 119

Dafila acuta, 122
Dahlia, 86
Daisy, 266, 274
Daltonism, 340
Damaliscus lunatus, 363
Damp as a check to multiplication of species, 350, 351
Danaidæ, 175, 179, 215, 216, 226, 228
Danais chrysippus, 179, 250
Danger signal, 183, 214, 253, 254
Darter, 277
Darwin, 1-12, 14, 25-27, 31, 35, 42, 52, 54-7, 59, 60-3, 68, 83, 96, 112, 114-7, 119, 123, 127, 130, 151, 171, 175, 182, 184, 233, 259, 299, 301-8, 316, 319-21, 325, 326, 347
"Darwin and after Darwin," 370-5, 377, 381
Darwinian theory, 3, 5-8, 11, 13, 27, 28, 35, 42, 45, 52, 75, 111, 171
Darwinism, 1, 7, 8, 11, 14, 26
"Darwinism," 40, 53, 112, 117, 178, 207, 213, 228, 322, 323
"Darwinism To-day," 16, 45, 67
Dasyurus, 283
De Candolle, 86
Decorative plumage, 40
Deer, 101, 120, 180, 298
Deerhound, 304, 308
Deer-ponies, 125
Degeneration, 168
Dejerine, 340
Delage, 33, 147
Delbœuf, Law of, 373
Delias eucharis, 216, 220, 221
Demiegretta, 100
Demoiselle crane, 277
"Descent of Man," 234, 299, 301, 302, 304, 305, 319, 320, 326
Determination of sex, 165
"Development and Heredity," 17
De Vries, 26, 66, 69-72, 75-8, 82-9, 95, 105, 118, 151
Dewar, D., 43, 44, 47, 48, 195, 204, 206, 208, 210, 225, 233, 236, 303, 308, 309, 354, 360, 378
Dewar, G. A. B., 196, 197
Dicrurus ater, 179, 233
Didelphys nurina, 243
Dimorphism, sexual, 51, 200, 201
Dipsacus, 58
Disease as a check to multiplication of species, 351
Dissemurus paradiseus, 179, 220
Divergence of character, 367
Dog, 59, 68, 99, 100, 125, 225, 226, 282, 283, 304, 308, 352, 357, 364, 365
Dog-rose, 261
Dolphin, 99
Dominant characters, 142
Donald, Mr D., 256
Dragon-fly, 216, 264
Driesh, 136
Drongo cuckoo, 233
Drongo-shrikes, 179, 220
Drummond, 382
Duck, 51, 60, 68, 97, 99, 100, 122, 126-8, 190, 247, 249, 282, 292, 314, 315, 334, 337, 338, 365
Duiker-buck, 243
Dyer, Sir William Thistleton, 26

Eagle, 65, 190, 350
Eagle-owl, 221
East, M. E., 79
Echis carinata, 224
"Eclipse," 69
"Edinburgh Review, The," 38
Eel, 102
Eggs, colours of birds', 206-9
Egret, 100, 206, 254, 365
Eider-duck, 249
Eimer, 15, 16, 33
Eisig, 222
Elanoides furcatus, 282
Elaps, 197, 198
Elder, 49
Elementary species, 77, 78, 87, 88, 89
Elk, Irish, 67
Emberiza citrinella, 289
E. pyrrhuloides, 98
E. schœniclus, 98
Entomophila picata, 281
Entomophilous flowers, 261
Epenthesis folleata, 103
Epilobias, 260
Equus, 41
Erebia manto, 381
Erythrura prasina, 102
"Essays on Evolution," 11, 173, 177, 181, 184, 213, 223, 226, 227, 229, 230, 231, 234, 237, 238, 239

Index

Estrelda cyanogastra, 104
E. phœnicotis, 104
Ether, 152, 153
Euchelia jacobacæ, 227
Eurasian, 140
European, 140
Euxenura maguari, 282
Evening primrose, 84, 85, 88
"Evolution of Sex, The," 306
Existence, struggle for, 31, 32
Eye-colour in human beings, 310
Eyesight of birds, 211, 237-41
—— insects, 264
Eyton, 15

"Faery Year, The," 196
Falcon, 204, 246, 250
Falco peregrinator, 251
F. severus, 251
False mimicry, 243
Faults in poultry, 64
Ferrets, 100, 119
Finch, 117, 120
—— Bicheno's, 105
—— chestnut-breasted, 98
—— cut-throat, 122
—— Gouldian, 98
—— Nonpareil, 102
—— red-headed, 142
—— ringed, 104
—— saffron, 244
—— yellow-rumped, 98
Finn, 99, 102, 115, 131, 179, 216, 219, 220, 235, 241, 255, 304, 309, 310, 313, 315, 316, 358
Fittest, survival of the, 32
Flowers, 65, 66
Flowers, colours of, 258-75
Fly-catchers, 44, 45, 47, 285, 338
Flying squirrel, 243
"Fortnightly Review, The," 37, 38
Foul-brood, 353
Fowl, 56, 58, 61, 64, 65, 99, 101, 125, 127, 128, 282, 301, 302, 307, 314, 330, 336, 338, 339, 361, 362, 364, 365
Fowl-ducks, 125
Foxes, 101, 131, 190, 191
Fox-terrier, 19
Franqueiro cattle, 95
Francolinus pondicerianus, 337
Friar-bird, 249
Fringella coelebs, 209
Fritillary butterfly, 103
Frog, 325
Fruits, colours of, 258, 275
Fuligula marila, 290
Fulmar petrel, 190
Function, change of, 36, 37
Fungi, 263

Gadow, Dr, 197, 245
Gadwall, 126, 315
Galton, 81, 82, 374
"Game Birds and Wild Fowl of India," 131
Gametes, segregation of, 143-5
Gannet, 282
Gayal, 126
Gauchos, 359
Gecko, 210
Geddes, 306, 326
Gemmules, 151
"Genesis of Species," 7, 61
Geographical isolation, 375
Geological record, imperfection of, 40-2, 94
Geranium, 260
Germ-plasm, continuity of the, 25
Germinal variations, 106-10
Geum urbanum, 263
Gibbon ape, 101
Giraffe, 17, 18, 192, 196
Globicera, 104
Glutton, 190
Goat, 283
Goethe, 2
Golden pheasant, 97, 129, 149, 337, 338
Golden tench, 101
Goldfinch, 127, 255
Goldfish, 101, 102
Goose, 99, 100, 105, 115, 121, 130, 190, 281, 316, 334, 339
Gordon's currant, 119
Goshawk, 247
Gouldian Finch, 99
Graba, 58
Gradation of colour, principle of, 185
Graculipica melanoptera, 244
"Grammar of Science, The," 309
Grass, 273
Grasshopper, 185
Greenfinch, 122

Greyhound, 364
Grosbeak, 281, 284
Groundsel, 260
Grouse, red, 125
Growth-force, 15, 16, 68
Grus leucogeranus, 282
Guillemot, 58, 190, 245
Guinea-fowl, 100, 127, 128, 279, 362
Guinea-pig, 95, 101, 129, 283
Gulick, 369, 372-7, 380
Gull, 190, 191, 207, 247, 290, 355
Gygis, 278
Gyrfalcon, 190

HAECKEL, 15, 24
Hæmophilia, 340
Halcyon smyrnensis, 202
Haliætus albicilla, 65
Hare, 131, 185, 200
Harrier, 101
Hartebeeste, 363
Hawk-cuckoo, 235, 236
Hawk-eagle, 101
Hawks, 222, 235, 236, 247, 277
Hecki, 104
Helice, 103
Heliconidæ, 175, 215, 216, 228
Heloderm, 217
Henslow, 15, 22, 23, 47, 48, 259
" Heredity," 103, 145, 166, 340
" Heredity of Acquired Characters in Plants," 22, 48
" Heredity of Sexual Characters in relation to Hormones," 19, 330
Heron, 250, 317
Herring, 193
Hertwig, 151
Heusinger, 357
Hewitt, Mr, 307
Hierococcyx varius, 235, 248
Hilversum, 84
Himalayan argali, 120
Hinny, 127, 136, 140, 162
Hipparchia, semele, 205
Hippotragus equinus, 334
H. niger, 334
Hirundo rustica, 251
H. tytleri, 251
" History of Creation," 24
Hobby, 250, 251
Homogamy, 370
Honeyeater, 281
Hormones, 335, 338
Hornbill, 65, 220
Horner, 340
Horse, 61, 68, 69, 95, 96, 100, 101, 117, 127, 128, 140, 266, 267, 268, 272, 283, 322, 389, 363, 364, 374
Horse, genealogy of, 41
Houghton, 91
Howard, 315, 332
Hubrecht, 26
Hume, 131
Humming-bird, 328
Hutton, 3
Hutton, Captain, 115, 382
Huxley, 3, 6, 11, 40, 100, 111
Hyæna, 353
Hybridism, 111-32, 292, 293
Hydra, 21
Hydrogen, 152, 153
Hydrophasianus chirurgus, 250
Hyla, 245
Hypertely, 237, 240
Hypolimnas misippus, 179, 180

" IBIS, THE," 255, 256
Icterus vulgaris, 244, 281, 284
Impeyan pheasant, 104
Indian Civil Service, 385, 386, 387
Indian corn, 81
Inheritance, 133-69
—— alternative, 127
—— blended, 140, 148
—— definition of, 138
—— of acquired characters, 10, 14, 15, 18-24, 60, 107-10
—— particulate, 140
—— unilateral, 139, 140, 162
Insectivores, 67
Intercrossing, swamping effects of, 42, 83
Intimidating attitudes, 224, 225
Iora, 244
Iridescence, 186
Irish elk, 67, 168
Isolation, 366-82, 387
Isomerism, biological, 154-8
—— chemical, 152-4, 157
Ithomiinæ, 228, 246
Ivy, 261

JACANA, 250
Jackdaw, 51, 306
Jaeger, 86

Index

Jaguar, 45, 358
Japanese greenfinch, 122
—— pheasant, 122, 124, 129
Jardin des plantes, 88
Java sparrow, 99, 100
Jelly-fish, 192
Jesse, W., 255
Johnston, 92
"Journal of the Bombay Natural History Society," 209
"Journal of the Royal Society of Arts," 236, 324, 378
Jungle-babbler, 179
Jungle fowl, 332

Kallima, 45, 47, 209, 212, 235, 386
Kellog, 16, 26, 45, 47, 67
Kingfisher, 202, 203, 206
Kite, 282
"Knowledge," 171, 198, 277
Korchinsky, 15, 33
Krait, 216, 247
Kuppa, 224

Labernum, 119
Lachnanthes, 357
Ladybird, 213, 214
Lamarck, 2, 14, 17, 52
Lamarckism, 16, 24, 25
Lambert, Edward, 341
Lankester, Sir E. Ray, 13, 25
Lapwing, 207
Lark, 185, 362
Larus ridibundus, 290
Latent characters, 149
Law of battle, 301, 302, 321
Leaf-butterfly, 45, 47, 209, 235, 386
Lemming, 190
Lemur, 242, 243
Lemur catta, 242
Leopard, black, 101, 354, 358
Leucopternis, 282
Ligurinus sinicus, 122
Lily, 146
Linaria vulgaris peloria, 86
Linden, Gräfin von, 155
Links, missing, 41, 42
Linnæus, 65, 115
Linnet, 212, 338
"Linus I.," 95, 96
Lion, 192, 334, 349, 352
Liothrix luteus, 179
Lizard, 64, 207, 210, 212, 216, 217, 220, 223, 269, 350
Loddigesia mirabilis, 328
Loeb, 147
Lophophorus chambanus, 104
L. impeyanus, 104
Lucerne, 118
Lung, 36, 37
Lutinism, 102
Lycæna donzelli, 381
L. pheretes, 381
Lycodon aulicus, 247
Lyell, 3

Mackerel, 193
Madingly, 102
Mænia typica, 221
Magnus, 86
Magpie, 281
Magpie colouring, 66, 67, 280, 281
Magrath, 256
Male-fern, 49
Mallard, 65, 97, 122, 126, 132, 293, 313, 315, 334, 337
Malthus, 31
Malva, 260
Manchester School, 27
Mannikin, 104
Marbled newt, 124, 245
Marshall, 28
—— Mr G. A. K., 239
—— Milnes, 37, 174
Marsupials, 67
Masters, 86
"Materials for the Study of Variation," 73, 103
Mauchamp sheep, 95
Mayer, 228
"Mechanischphysiologische Theorie der Abstammungslehre," 15
Medicago media, 118
Megascops asio, 44
Melanism, 64, 101, 360
Melopsittacus undulatus, 101
Mendel, 42, 74, 136, 141, 142, 144, 145
Mendel's Law, 145, 149, 150, 161
Mendelism, 145
Mesohippus, 41
Micellæ, 151
Micropus melanoleucus, 245
"Mikado, The," 237
Mildew, 49

Mimicry, conditions of, 178
Mimicry, protective, 45, 50, 51, 173, 177-82, 226-51, 275, 293, 294
Mink, 243
Miohippus, 41
Missing links, 41, 42
Missouri currant, 119
Mivart, Dr St George, 7, 61
Mole, 180
Molge blasii, 124
M. cristata, 124
M. marmorata, 124
M. vulgaris, 221
Mollusca, 49
—— of Sandwich Islands, 375, 378
Molpastes, 123, 255
Molpastes bengalensis, 256, 379
M. burmanicus, 379
M. hæmorrhous, 255, 379
M. intermedius, 256, 379
M. leucogenys, 256
Monaul, 104
Monkey, 64, 213
Monotypic evolution, 366
Monstrosities, 56, 57, 358
Morgan, Prof. Ll., 368
—— T. H., 26
Morse, 190
Moseley, Prof., 311
Motacilla lugubris, 122
M. melanope, 122
Moth, 101, 102, 124, 209, 215, 227, 238, 240
Mouse, 64, 105, 139, 141, 146, 149, 150, 180, 185, 282, 359
Mule, 127, 136, 140, 160, 162
Müller, Fritz, 81, 180
Müllerian mimicry, 177, 181, 182
Munia atricapilla, 104
M. castaneithorax, 98
M. flaviprymna, 98
M. malacca, 104
Muscovy duck, 99, 127, 128, 281
Musk ox, 190, 192
Mustela sarmatica, 243
Mutations, 41, 43, 66, 69, 72, 75-105, 124, 127, 134, 159, 160, 169, 223, 280, 281, 284, 292, 295, 339, 341, 342-4, 380-8
Mutations, theory of, 26, 38, 75, 76, 95
Myna, 244
Myristicivoræ, 282

NAEGELI, 15, 16, 151
Nahrwal, 190
Natural selection, theory of, stated, 31, 32
"Nature," 184
Nautili, 67
Nectar of flowers, 262, 264, 265, 268, 270, 271
Neo-Darwinians, 13, 14, 25, 173, 174, 176, 188, 214, 218, 222, 233, 238, 242, 263, 264
Neo-Darwinism, 51, 172, 234, 235, 264, 275, 276, 297
Neo-Lamarckians, 13, 14, 15
Neophron, 282
Nepheronia hippia, 179
Nettium albigulare, 179
New organs, beginnings of, 36, 73
Newman, 126
Newt, 124, 221, 222
Niata cattle, 95
Nicobar pigeon, 65
Nilgai, 337
Nitrogen, 153
Noddy, 62, 279
Nonpareil finch, 102
Nyroca africana, 337

OATES, 255, 379
Obliterative colouration, 184-7
Ocydromus, 365
Œnis, 205
Œnopopelia tranquebarica, 122, 123, 324, 333
Œnothera lamarckiana, 84, 85, 87, 88
Ononis repens, 23
O. spinosa, 22
Opossum, 243
Orchid, 268, 269, 270, 272
Orgyia antiqua, 215
"Origin of Species, The," 7, 9, 11, 31, 53, 57, 63, 114, 170, 194, 347, 348, 356, 367
Oriole, 244, 249, 284, 304
Oriolus galbula, 282
O. kundoo, 282
O. melanocephalus, 244, 284
"Ornithological and Other Oddities," 255
Orohippus, 41

Orr, 15-7
Orthogenesis, 15, 16, 34
Ossifraga gigantea, 99, 362
Otidiphaps insularis, 244
Ovis ammon, 120
O. vignei, 120
Owen, Sir Richard, 7
Owl, 247, 277, 289
—— little, 97, 98
—— scops, 101
—— snowy, 190
Ox, 146, 352
Oxygen, 152, 153, 263

PADDY BIRD, 254
Paint-root, 357
Palæornis torquatus, 102, 325
Pallas, 115
Pansy, 260
Panther, 360
Papilio, 228, 246
P. aristolochiæ, 179, 216, 220, 221
P. polites, 179
Paradise, bird of, 62, 249
Paradise flycatcher, 47, 202, 298, 303, 316, 324, 338
Paradisea apoda, 249
Paraguay cattle, 94
Parnassius apollo, 155
Paroquet, 102, 121, 325
Parrot, 103
Parthenogenesis, 135, 138
Partridge, 185, 315, 337
Parus leucopterus, 245
Passer domesticus, 289, 342
P. montanus, 342
P. swainsoni, 342
Pasteur, 5
Pavo nigripennis, 96
Pavoncella pugnax, 343
Pea, sweet, 74, 75, 81, 141
Pear, 72
Pearson, Karl, 309, 310
Peckham, 308
Pekin robin, 179
Pelagic animals, 173, 192-4
Penguin, 191
Pennant's parakeet, 121
Petaurus breviceps, 243
Petrel, 44, 190, 191, 277, 337
Pfeffer, 33
Phalacrocorax carbo, 381
Phalanger, 243
Phalarope, 327
Phasianidæ, 125, 330
Phasianus colchicus, 114, 123
P. torquatus, 114, 123
P. versicolor, 114, 123, 124
Pheasant, 97, 104, 114, 121, 123, 128-30, 141, 315, 336, 338
Pictet, 155, 156
Pieris napi, 155
Piezorhynchus, 285
Pig, 57, 283, 357, 365
Pigeon, 61, 62, 65, 68, 71, 72, 91, 92, 93, 98, 101, 109, 126, 127, 244, 277, 282, 353, 357, 364, 365
Pigment, massing of, 256
Pike, 102, 222
Pimpernel, 261
Pintail duck, 130, 132, 293, 337
Pintailed nonpareil finch, 102
"Plant Breeding," 87
Plasomes, 151
Plastidules, 151
Platycercus elegans, 121
P. erythropeplus, 121
P. eximius, 121
Pliohippus, 41
Plover, 207
Plumage, decorative, 40
Pochard, 126, 337
Pœcilomeres, 288-95
Poëphila mirabilis, 99
Polar bear, 119, 130
Polar bodies, 135
Polecat, 119
Polytypic evolution, 367
Poppy, 82, 261
Porzana bailloni, 251
P. pusilla, 251
Post-nuptial display, 316
Potentilla tormentilla, 263
Poulton, 11, 25, 26, 171, 173, 177, 181, 184, 210, 213, 217, 221, 223-5, 229-35, 238-42
Precis artexia, 203, 204, 212
Preferential mating among human beings, 309, 310
Prepotency, 136
Prickly pear, 274
Primrose, evening, 84, 85, 88
Pritchard, Hesketh, 359
"Proceedings of the Fourth International Ornithological Congress," 288, 337

"Proceedings of the Linnæan Society," 288
"Proceedings of the Natural History Society of Brunn," 141
Protohippus, 37
Pseudoclytia pentata, 103
Pseudo-sematic colours, 173
Pseudotantalus cinereus, 282
Ptarmigan, 190
Pteroclurus exustus, 204
Puffin, 191
Pugnacity of animals, 206, 360
Puma, 45
Purple beech, 87
Pycraft, W. P., 277
Pycnorhampus affinis, 284
P. icteroides, 284
Pygæra bucephala, 215

QUAIL, 185
Quatrefages, de, 124
Quelea quelea, 98
Q. russi, 98
Querquedula crecca, 290
Quetelet's Law, 77

RABBIT, 99, 100, 105, 183, 253, 283, 350, 352
Racehorse, 69
Radicles, biological, 159
Rallus aquaticus, 251
R. indicus, 251
Ranunculus bulbosus, 70
Rappia, 245
Raspberry, 118
Rat, 74, 282
—— water, 101
Raven, 190
Razorbill, 190
Recessive characters, 142
Recognition colours, 251-7, 275
—— marks, 124
Red-mantled parakeet, 121
Redpole, 207
Redwing, 354
Reed bunting, 98
Reeves' pheasant, 129
Regression, Law of, 82, 374
Reid, Archdale, 5
Reindeer, 190
Rest-harrow, 22
Reversion, 64, 65, 129, 293
Rhinosciurus tupaioides, 180
Rhodocera rhamni, 155
Rhododendron ferrugineum, 118
R. hirsutum, 118
Rhynchæa, 327
Ricardo, 28
Ringed finch, 104
Robin, 281, 378
Robin, Indian, 202
Robinson, Dr H., 171, 198
—— E. K., 261, 264, 265, 266, 268, 270, 272-4
Rodents, 67
Rogeron, 126
Roller, 123, 220, 255
Romanes, 366-81
Rook, 51, 187
Rose, 61, 267
Rosella parakeet, 121
Rous, Admiral, 69
Roux, 136
Ruff, 343

SABLE, 190
Saffron finch, 244
Sainfoin, 267
Salamander, 217, 219, 221
Salix alba, 118
S. pentandra, 118
Sandgrouse, 204, 351
Sandpipers, 185, 190
Sassaby, 363
Satyridæ, 205
Scatliff, H. P., 91-3
Scatliff strain, 91
Scaup, 290
Schmankewitsch, 156
"Science," 166
Sciuropterus volucella, 243
Scops giu, 101
Scops owl, American, 44
——, Indian, 101
Scoter, 249
Seal, 190, 191
Sea-urchin, 149
Seaweed, 263
Sebright, Sir John, 63
Secondary sexual characters, 298
Segregation, 369
—— of gametes, 143-5
Selous, Edmund, 308
—— F. C., 192, 195, 197, 203
Sematic colours, 173
Sesia fuciformis, 178

Index

Sexual dimorphism, 51, 297-344
Sexual selection, theory of, 299-321
Shaheen, 251
Shamrock, 274
Sheathbill, 191
Sheep, 95, 266, 267, 283, 357, 372
Sheldrake, 109, 129
Shikra, 235, 236
Shoveler, 290
Shrew, 180, 216
Sidgwick, 28
Sidney, 5, 49
Sika deer, 120
Silver-washed fritillary butterfly, 103
Siskin, 127, 244
Skua, Arctic, 44, 362
Skua-gull, 191
Skunk, 186, 217, 221
Skylark, 315
Slug, 49, 185
Smith, Adam, 28
Snake, 185, 197, 198, 217, 220, 223-6, 247, 356
Snap-dragon, 268, 272
Snipe, 69, 327
Sodium sulphate, 151
Somatic variations, 106-10.
"Some Indian Friends and Acquaintances," 225, 358
Sorrel, 274
Sparrow, 213, 241, 341, 342
—— Java, 99, 100
Sparrow-hawk, 235, 243
Spatula clypeata, 290
Spavin, 332
"Species and Varieties," 69, 77, 84, 87, 118
Species, definition of, 89
Species, elementary, 77, 78, 87-9
Spencer, 3, 15, 16, 28, 38, 151
Spider, 269, 272
Sporæginthus amandava, 311
Sports, 41, 43, 66, 75, 85, 135
Squirrel, 101, 186, 243
Stag, 325
—— Irish, 67
Standfuss, 155
Stanley crane, 248, 279
St Hilaire, T. G., 2, 356
Stick insect, 209
Stictoptera annulosa, 104
Stoat, 119, 190, 290
Stolzmann, 327-9, 342, 343
Stonechat, 353
Stork, 247, 282
"Strand Magazine," 64
Strix flammea, 289
Struggle for existence, 31, 32, 48
—— for nourishment, 167
Suchetet, A., 126, 130
Sula capensis, 282
S. serrator, 282
Sunbird, 324
Surniculus lugubris, 235, 243
Survival of the fittest, 32
Survival value, 33, 34
Swallow, 250, 251, 279, 361
Swallow-shrike, 281
Swallow-tail butterfly, 179
Swan, 100
Swift, 243, 250
Swimming bladder of fishes, 36, 37
Sycalis flaveola, 244
Syrphidæ, 178

TACHYCINETA LEUCORRHOA, 361
Tadorna cornuta, 129
T. tadornoides, 129
Tails, 62, 64
Tait, Mr, 356
Tanager, 281
Tapir, 42
Tasmanian devil, 282
Teal, 290, 316
Teasel, fuller's, 58
Teeth, molar, 105
Tegetmeier, Mr, 307
Tern, 62, 278
Terpsiphone paradisi, 202, 298, 304, 316, 324
Tetraogallus, 337
Tetraonidæ, 125
Tetrapteryx paradisea, 249
Tetrao tetrix, 129
T. urogallus, 129
Thamnobia cambayensis, 202, 275
T. fulicata, 202, 378
Thayer, Mr Abbot, 184-7
Thompson, Seton, 354
Thomson, 103, 136, 145, 166, 306, 326, 340
Throat disease, 353
"Through Southern Mexico," 197, 245
"Through the Heart of Patagonia," 359

Thrush, 203, 207, 355
Tiger, 334
Tit, 245
Toad, 210, 219, 241
Toad-flax, 56
Tortoise, 222
Trefoil, 274
Trochilium, 229
Trogon, 62
Tropidonotus piscator, 220
Troupial, 244, 281, 284
Tsetse-fly, 352
Tupaia, 180, 216
T. ellioti, 216
Turbit, 72, 91-3
"Turbit, The Modern," 91
Turkey, 95, 363
Turnspit dog, 59
Turtur cambayensis, 333
T. suratensis, 333
T. risorius, 33, 123, 126
Tylor, Mr Alfred, 287

UNGULATES, 67
Unilateral transmission, 341
Unit characters, 148-52
Uria grylle, 245
U. lacrymans, 58
Urial, 120, 130, 131
Urodynamis tritensis, 243

VALEZINA, 103
Vanessa levana, 154
V. prorsa, 154
Vapourer moth, 215
Variation, 52-110
—— cause of, 59-60
—— continuous, 56, 69, 76, 105
—— definite, 55
—— determinate, 55
—— discontinuous, 43, 56, 72, 73, 76, 78, 79, 87, 105, 106, 133, 159, 295
—— germinal, 106-10, 133
—— indefinite, 55, 59
—— somatic,
Viola, 260
V. tricolor, 260
Volckamer, 86
Vulture, 282

WAGGETT, 12
Wagner, 369, 372
Wagtail, 122, 203
Wallace, 3, 10, 13, 14, 25, 26, 35-42, 53, 112, 114, 116, 117, 171, 175, 177, 183, 184, 207, 213, 228, 230, 251, 253, 256, 287, 296, 308, 321-7, 343, 372, 377
Wallaceian school of biologists, 14, 24, 25, 47, 192, 210, 251, 346, 347, 366, 377
Wallaceism, 172, 202
Walrus, 190
Warblers, British, 315, 332
Warning colours, 173, 176, 198, 212-26
Wasp, 174, 178, 179, 214, 227
Wasp-beetle, 229
Water-rail, 251
Waxbill, blue-bellied, 104
Weasel, 190
Weaver, red-billed, 98
Weber, 86
Weir, Mr Jenner, 299
Weismann, 25, 106, 107, 151, 154
Weka rail, 365
"Westminster Review," 112
Weston, G. E., 127
Whale, 42, 185, 190, 193
Wheatear, 253
Whinchat, 253
Wiesner, 151
Wilson, Prof. E. B., 166
Winter coat, 188
Wolf, 48, 130, 185, 192
Wonder horse, 95, 96
Woodpecker, 102
Wright, Mr, 304
Wyman, Professor, 357

X-ELEMENT, 165

YAK, 120
Yarrow, 268
"Year-book of the Smithsonian Institution," 184
Yerbury, Col., 239
Youatt, 63

ZEBRA, 196
Zebu, 120
Zocher & Co., 56
Zoological Gardens, Lahore, 309
——, London, 104, 119, 126, 130, 206, 304, 316
Zoological Society of London, 330
Zygæna filipendulæ, 102

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The Menace of Darwinism

By

WILLIAM JENNINGS BRYAN

Being a reissue of chapter four from the author's volume "In His Image," together with comments on the importance of its appeal, reasons for its separate publication and an abstract of the remaining chapters



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Preface

IT has been decided to publish, in booklet form, Chapter IV from "In His Image."[1] The complete work contains nine religious lectures delivered by the author in October, 1921, at the Union Theological Seminary, Richmond, Virginia, and this Preface is intended to give a brief review of the book from which the chapter is taken. The original title of this chapter was "The Origin of Man," but as it deals with Darwinism and the effect of that hypothesis upon religious thought, the title is changed to "The Menace of Darwinism," in order to emphasize its dominant note.

The hypothesis to which Darwin's name has been attached was not original with him. Before the beginning of the Christian era vague suggestions had been made attributing to man a brute origin, but Darwin advanced explanations of the changes made necessary by such an hypothesis and outlined a family tree by which he attempted to connect man with all animal life below him. He applied the doctrine of evolution to man more definitely and defended it more elabo-

[1] "In His Image," by William Jennings Bryan. 12 mo, 266 pages—$1.75. Fleming H. Revell Company.

rately than any one else had done. While the two propositions which he advanced to explain man's descent from the brute, viz., "natural selection" and "sexual selection," have been largely discarded, the idea of a brute descent still lives among evolutionists and, in my judgment, is at present the only serious attack upon the fundamental fact of God and upon the great and controlling influences that rest upon belief in God.

Darwin's views made the holder thereof an agnostic, led him away from belief in the Bible, God, and Christ; and, as I prove in this lecture, the natural tendency of Darwinism is to lead those astray who put their faith in evolution. I speak now of the *tendency*. It is dangerous not because *always* fatal but because it is *so often* fatal. Only a small percentage of those who take smallpox die of that disease, and yet we quarantine against smallpox, and no one is permitted to communicate the disease to others. The spiritual mortality, as I show by quotations from Leuba, is greater among those who adopt Darwinism than is the physical mortality among those who are afflicted with smallpox.

The *tendency* of Darwinism, when taken seriously, is to undermine faith, first, in the Bible as an inspired book, and then in the miracles because contrary to evolution; next, repudiation of the virgin birth and the resurrection of Christ because miraculous, and the rejection of Christ as Son and Saviour. Lastly, Darwinism leads to the denial of the existence of a personal God.

Evolutionists are divided into two classes—atheistic evolutionists, who do not admit the existence of a Supreme Being at all, and theistic evolutionists, who travel with the atheists to the *beginning of life* and then assume the existence of God as Creator of life. While the theistic evolutionist does not affirmatively deny God, he is more dangerous to Christian faith than the atheist, because, while claiming to believe in a Creator, he puts God so far away that consciousness of God's presence loses its power to comfort. How can one be conscious of God's presence in his daily life if God has never, since life began, touched a human heart or put His hand upon the destiny of nations or individuals? Evolution also paralyzes the sense of responsibility to God. What compelling force can a sense of responsibility have if it must be strained through the blood of all the animal life below man? Nearly all atheists come from the ranks of the theistic evolutionists. Theistic evolution may be described as an anesthetic which deadens the pain while the patient's religion is being gradually removed, or it may be likened to a way-station on the highway that leads from Christian faith to No-God-Land.

The special reason for bringing to the attention of Christians at this time the evil that Darwinism is doing is to show that atheists and agnostics are not only *claiming* but *enjoying* higher rights and greater privileges in this land than Christians; that is, they are able to propagate their views at *public expense* while Christianity must be taught at the *expense of Christians.* Whenever Christians, whether Protestant or Catholic,

desire to present to students their interpretation of Christianity they build their own colleges with their own money, employ their own teachers, and give to the school a name which indicates what is being taught. Is there any reason why atheists and agnostics should not be compelled to do likewise? If they desire to teach that there is no God and therefore no Bible and no Christ, why do they not build their own colleges and support them? Christians do not deny to atheists the right to dispute the existence of God or to agnostics the right to declare themselves without an opinion on the subject; Christians do not deny the right of atheists and agnostics to *teach* their views; Christians would put all on the same level. The question in dispute is whether atheists and agnostics have a right to teach *irreligion* in public schools—whether *teachers drawing salaries from the public treasury* shall be permitted to undermine belief in God, the Bible, and Christ by teaching not scientific truth but unproven and unsupported guesses which cannot be true unless the Bible is false.

The reader may know more of the character of "In His Image" by the following summary:

Chapter I deals with the existence of a Supreme Being, all-wise, all-powerful, and all-loving—self-existent and the Creator of all things. Under this head attention is called to a rebuke which Tolstoy delivered to "the cultured crowd" who think that religion is a superstition, good enough for the ignorant but unnecessary when one reaches a certain period of intellectual development. It is this idea of substituting

education for *religion* that is threatening to overturn man's philosophy of life. The great Russian philosopher declares that religion does not rest upon a vague fear of the unseen forces of nature but upon man's consciousness of his finiteness amid an infinite universe, and of his sinfulness. "This consciousness," Tolstoy added, "man can never outgrow."

An answer is given to those who condemn religion because of its mysteries. Life, love, patriotism, and all other things with which man deals are full of mystery and yet we live, we love, and are patriotic. If we only apply to religion the same common sense that we apply to daily life we shall put into practice that which we *do* know instead of being distracted by that which we may never be able to know. If man only lives up to so much of the Bible as he does understand he will be too busy doing good to worry about passages which he finds difficult.

Belief in God is the basis upon which rest all the great influences that control our lives—all these will go if belief in God goes. The existence of God, therefore, becomes the basic fact not only in religion but in society and civilization.

Chapter II deals with the Bible as the Book of books. It is either a man-made book or a book by inspiration given. Those who believe it to be a man-made book are challenged to put their theory to the test. If man made the Bible, man ought to be able to make a better book to-day than the Bible. If the Bible is a man-made book, it must be remembered that it was made by a comparatively few persons of a single

race, living in an area not as large as some of our American counties, who had no great universities to train them for their work, no great libraries to consult, no swift ships to carry them to the different centers of civilization, no telegraph to bring them news from every corner of the earth. Yet they grappled with every problem that confronts mankind, from the creation of the world to life beyond the grave. They gave us a diagram of man's existence and set up warning signs at every danger point. If the Bible be of human origin, why is it that, with all the advance in wealth, education, and invention, mankind does not produce a better book?

In one chapter Moses gives us three verses that more vitally concern man than all that can be found in all the books that uninspired man has written. "In the beginning God created the heaven and the earth," is the only sentence that gives us the origin of life; second, the command that established reproduction according to kind; that is the only law governing the continuity of the race; and, third, the making of man in God's image; that is the only explanation of man's existence on earth.

No substitute ever proposed for the first verse of the Bible is as easily understood, believed, and defended.

The law of reproduction according to kind is inviolable. Even man is not able to lead or compel that intangible, invisible thing that we call life to cross the line of species.

And no man without revelation has ever been able

to guess the riddle of man's existence. How can he? Man is born into this world without his own volition; he has nothing whatever to say as to the age in which he will live, the land in which he will be born, the race of which he will be a member, the family which will furnish the environment of his infancy and youth, or even his sex. So far as he is concerned, he comes by chance, knows not how long he will stay, or how or when he will go hence.

But when man knows that God, after making all other things, made man, *not as He made all other things but in His own likeness,* appointed him commander-in-chief of all that is and put the destiny of the earth into his hands, he finds himself. He learns from God's Word that while all is *for* him he must render account for every moment of his life, every atom of his power and every ounce of his influence. The Heavenly Father has linked happiness to virtue and success to righteousness, exacting from man in return only one thing—obedience.

Where in all other books can be found so much that is vital to man? And besides these three verses we have—the inspiration of the prophets, the consolation of the Psalms, the instruction that comes from the record of God's dealing with a chosen people; then the New Testament with the story of Jesus and His atoning blood, a code of morality that is to endure for all time and a gospel for every human being. Behind all these we have Christ Himself, with all power in heaven and earth in His hands, and His promise, " Lo, I am with you alway, even unto the end of the world."

The Bible gives us the world's only conception of God; it gives us our only conception of Christ, and it gives us *itself* as an infallible guide.

The Bible must be rejected or defended. If it be false, it is the most stupendous impostor the world has ever known; if, on the other hand, it be true, as we believe it is, no book can be compared with it—nothing in all the writings of men can approach it.

Chapter III deals with Christ and takes up the various theories in regard to Him. Was He a fraud? Did He make a claim to power under a delusion? Or was He what He claimed to be, "The Way, the Truth, and the Life"? It presents Christ as Son of God and Saviour of the world, and offers in proof of His claim what He said and did and was. Born in a manger, reared in a carpenter shop, and yet, when only about thirty years of age, He gave the world a code of morality the like of which the world had never seen before and has not seen since, preached for a few months, gathered around Him a few disciples, and then was crucified and His disciples scattered, or put to death. Yet, from this beginning, His influence has grown until hundreds of millions have been proud to bear His name and millions have been willing to die rather than surrender their faith in Him. He is the great fact of history and the growing figure of all time. It is easier to believe Him divine than to explain His life, His teachings, and the spread of the religion that bears His Name in any other way. The facts of history so fully support the claims of the Bible, and of the Bible's God and Christ that the burden of

proof is upon those who reject them, not upon those who accept them.

Chapter IV is the present reprint, and so speaks for itself.

Chapter V deals with "The Larger Life" and is built upon two Bible quotations. Paul tells us that Christ came to bring "life and immortality to light" —and the word "life" comes before the word "immortality." But we have a higher authority even than Paul; Christ in His explanation of His own mission said, "I am come that they might have life, and that they might have it *more abundantly.*" It is to the more abundant life that Christ calls us. The chapter contains illustrations of the manner in which Christianity can be applied to the individual, and shows that the Christian life is the only one in which true and lasting happiness can be found. The Christian philosophy is the only one that fits into every human need and furnishes a solution for every problem.

Chapter VI deals with the value of a soul—Christ's question, "What shall it profit a man if he shall gain the whole world and lose his own soul?" An effort is made to set forth God's law of rewards and to show how its universal adoption would solve the problems that perplex us, by limiting man's collections to his earnings. Illustrations are given to show that man may earn enormous sums, attention being called to the fact that those who earn the largest amounts, by giving an equivalent service in return, do not collect all they earn. Those who earn fabulous sums are so busy *earning* that they have not time to

collect, while those who collect fabulous sums are so busy collecting that they have no time to earn.

Chapter VII deals with the Bible account of the healing of the ten lepers, nine of whom were ungrateful. It applies this great lesson of ingratitude to the citizens of our own country. Three priceless gifts are used as illustrations; viz., Christianity, education, and popular government. Education is described as a gift rather than an accomplishment because it depends so largely upon inherited advantages and opportunities that come with the environment of youth. Quotations are given to show that many who receive the benefits of education are not only as ungrateful as the nine lepers but actually use against society the strength which education gives them. Wendell Phillips is quoted as saying that the *people* make history while the *scholars* only write it, part truly and part as colored by their prejudices. President Wilson is quoted as saying that the great voice of America does not come from seats of learning or even find an echo in the corridors of our universities. President Roosevelt is quoted as saying that there is scarcely a great conspiracy against the public welfare that has not Harvard brains behind it—and the charge applies to other universities as well as to Harvard. Emphasis is laid upon the duty of Christians to meet their obligations as citizens and on the Church to deal with all the problems that confront the world.

Chapter VIII deals with "His Government and Peace," and was suggested by verse seven of the ninth chapter of Isaiah: "Of the increase of his government

and his peace there shall be no end." In this chapter Christ's teachings are applied to government, a contrast being drawn between the attitude which man assumes when he deals with his fellowmen as a man and a brother wherein he is restrained by the ties of kinship, and the attitude of the brute when he devours with the savage hunger of the beast. A number of great reforms are traced to the teachings of Christ.

Chapter IX (the concluding one) is devoted to a discussion of public speaking. Rules are suggested for the use of those who present their thoughts from pulpit or platform. Attention is called to first essentials—knowledge of the subject and earnestness in its presentation, clearness of statement, brevity, illustrations, the question, faith in the triumph of the right, and the character of the speaker who stands back of what he says and gives force to it.

In the book as a whole, I have endeavored to present the fundamental principles of the Christian faith. It is intended for the average man; the arguments are presented in every-day language and the illustrations drawn from every-day life. Its purpose is to strengthen the readers' faith in a real God—a living Heavenly Father—in His Word as an infallible guide, and in Jesus Christ as Son, Saviour, and perfect Example for mankind.

THE ORIGIN OF MAN

WHEN the mainspring is broken a watch ceases to be useful as a timekeeper. A handsome case may make it still an ornament and the parts may have a market value, but it cannot serve the purpose of a watch. There is that in each human life that corresponds to the mainspring of a watch—that which is absolutely necessary if the life is to be what it should be, a real life and not a mere existence. That necessary thing is *a belief in God.* Religion is defined as the relation between God and man, and Tolstoy has described morality as the outward expression of this inward relationship.

If it be true, as I believe it is, that morality is dependent upon religion, then religion is not only the most practical thing in the world, but the first essential. Without religion, viz., a sense of dependence upon God and reverence for Him, one can play a part in both the physical and the intellectual world, but he cannot live up to the possibilities which God has placed within the reach of each human being.

A belief in God is fundamental; upon it rest the influences that control life.

First, the consciousness of God's presence in the life gives one a sense of responsibility to the Creator for every thought and word and deed.

Second, prayer rests upon a belief in God; communion with the Creator in the expression of gratitude and in pleas for guidance powerfully influences man.

Third, belief in a personal immortality rests upon faith in God; the inward restraint that one finds in a faith that looks forward to a future life with its rewards and punishments, makes outward restraint less necessary. Man is weak enough in hours of temptation, even when he is fortified by the conviction that this life is but a small arc of an infinite circle; his power of resistance is greatly impaired if he accepts the doctrine that conscious existence terminates with death.

Fourth, the spirit of brotherhood rests on a belief in God. We trace our relationship to our fellowmen through the Creator, the Common Parent of us all.

Fifth, belief in the Bible depends upon a belief in God. Jehovah comes first; His word comes afterward. There can be no inspiration without a Heavenly Father to inspire.

Sixth, belief in God is also necessary to a belief in Christ; the Son could not have revealed the Father to man according to any atheistc theory. And so with all other Christian doctrines: they rest upon a belief in God.

If belief in God is necessary to the beliefs enumerated, then it follows logically that anything that weakens belief in God weakens man, and, to the extent that it impairs belief in God, reduces his power to measure up to his opportunities and responsibilities. If there is at work in the world to-day anything that tends to

break this mainspring, it is the duty of the moral, as well as the Christian, world to combat this influence in every possible way.

I believe there is such a menace to fundamental morality. The hypothesis to which the name of Darwin has been given—the hypothesis that links man to the lower forms of life and makes him a lineal descendant of the brute—is obscuring God and weakening all the virtues that rest upon the religious tie between God and man. Passing over, for the present, all other phases of evolution and considering only that part of the system which robs man of the dignity conferred upon him by separate creation, when God breathed into him the breath of life and he became the first man, I venture to call attention to the demoralizing influence exerted by this doctrine.

If we accept the Bible as true we have no difficulty in determining the origin of man. In the first chapter of Genesis we read that God, after creating all other things, said, "Let us make man in our image, after our likeness; and let him have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth. So God created man in his own image, in the image of God created he him; male and female created he them."

The materialist has always rejected the Bible account of Creation and, during the last half century, the Darwinian doctrine has been the means of shaking the faith of millions. It is important that man should have a correct understanding of his line of descent.

Huxley calls it the "question of questions" for mankind. He says: "The problem which underlies all others, and is more interesting than any other—is the ascertainment of the place which man occupies in nature and of his relation to the universe of things. Whence our race has come, what are the limits of our power over nature, and of nature's power over us, to what goal are we tending, are the problems which present themselves anew with undiminished interest to every man born in the world."

The materialists deny the existence of God and seek to explain man's presence upon the earth without a creative act. They go back from man to the animals, and from one form of life to another until they come to the first germ of life; there they divide into two schools, some believing that the first germ of life came from another planet, others holding that it was the result of spontaneous generation. One school answers the arguments advanced by the other and, as they cannot agree with each other, I am not compelled to agree with either.

If it were necessary to accept one of these theories I would prefer the first; for, if we can chase the germ of life off of this planet and out into space, we can guess the rest of the way and no one can contradict us. But, if we accept the doctrine of spontaneous generation we will have to spend our time explaining why spontaneous generation ceased to act after the first germ of life was created. It is not necessary to pay much attention to any theory that boldly eliminates God; it does not deceive many. The mind revolts at

the idea of spontaneous generation; in all the researches of the ages no scientist has found a single instance of life that was not begotten by life. The materialist has nothing but imagination to build upon; he cannot hope for company or encouragement.

But the Darwinian doctrine is more dangerous because more deceptive. It *permits* one to believe in a God, but puts the creative act so far away that reverence for the Creator—even belief in Him—is likely to be lost.

Before commenting on the Darwinian hypothesis let me refer you to the language of its author as it applies to man. On page 180 of "Descent of Man" (Hurst & Company, Edition 1874), Darwin says: "Our most ancient progenitors in the kingdom of the Vertebrata, at which we are able to obtain an obscure glance, apparently consisted of a group of marine animals, resembling the larvæ of the existing Ascidians." Then he suggests a line of descent leading to the monkey. And he does not even permit us to indulge in a patriotic pride of ancestry; instead of letting us descend from American monkeys, he connects us with the European branch of the monkey family.

It will be noted, first, that he begins the summary with the word "apparently," which the Standard Dictionary defines: "as judged by appearances, without passing upon its reality." His second sentence (following the sentence quoted) turns upon the word "probably," which is defined: "as far as the evidence shows, presumably, likely." His works are full of

words indicating uncertainty. The phrase "we may well suppose," occurs over eight hundred times in his two principal works. (See *Herald & Presbyter*, November 22, 1914.) The eminent scientist is guessing.

After locating our gorilla and chimpanzee ancestors in Africa, he concludes that "it is useless to speculate on this subject." If the uselessness of speculation had occurred to him at the beginning of his investigation he might have escaped responsibility for shaking the faith of two generations by his guessing on the whole subject of biology.

If we could divide the human race into two distinct groups we might allow evolutionists to worship brutes as ancestors but they insist on connecting all mankind with the jungle. We have a right to protect our family tree.

Having given Darwin's conclusions as to man's ancestry, I shall quote him to prove that his hypothesis is not only groundless, but absurd and harmful to society. It is groundless because there is not a single fact in the universe that can be cited to prove that man is descended from the lower animals. Darwin does not use facts; he uses conclusions drawn from similarities. He builds upon presumptions, probabilities and inferences, and asks the acceptance of his hypothesis "notwithstanding the fact that connecting links have not hitherto been discovered" (page 162). He advances an hypothesis which, if true, would find support on every foot of the earth's surface, but which, as a matter of fact, finds support nowhere. There are myriads

of living creatures about us, from insects too small to be seen with the naked eye to the largest mammals, and, yet, not one is in transition from one species to another; every one is perfect. It is strange that slight similarities could make him ignore gigantic differences. The remains of nearly one hundred species of vertebrate life have been found in the rocks, of which more than one-half are found living to-day, and none of the survivors show material change. The word hypothesis is a synonym used by scientists for the word guess; it is more dignified in sound and more imposing to the sight, but it has the same meaning as the old-fashioned, every-day word, guess. If Darwin had described his doctrine as a guess instead of calling it an hypothesis, it would not have lived a year.[1]

Probably nothing impresses Darwin more than the fact that at an early stage the fœtus of a child cannot be distinguished from the fœtus of an ape, but why

[1] Dr. Etheridge, Fossiologist of the British Museum, says: "Nine-tenths of the talk of Evolutionists is sheer nonsense, not founded on observation and wholly unsupported by facts. This museum is full of proofs of the utter falsity of their views."

Prof. Beale, of King's College, London, says: "In support of all naturalistic conjectures concerning man's origin, there is not at this time a shadow of scientific evidence."

Prof. Fleischmann, of Erlangen, says: "The Darwinian theory has in the realms of Nature not a single fact to confirm it. It is not the result of scientific research, but purely the product of the imagination."

The January issue of "Science," 1922, contains a speech delivered at Toronto last December by Prof. William Bateson of London before the American Association for the Advancement of Science. He says that science has faith in evolution but doubts as to the origin of species.

should such a similarity in the beginning impress him more than the difference at birth and the immeasurable gulf between the two at forty? If science cannot detect a difference, *known to exist,* between the fœtus of an ape and the fœtus of a child, it should not ask us to substitute the inferences, the presumptions and the probabilities of science for the word of God.

Science has rendered invaluable service to society; her achievements are innumerable—and the hypotheses of scientists should be considered with an open mind. Their theories should be carefully examined and their arguments fairly weighed, but the scientist cannot compel acceptance of any argument he advances, except as, judged upon its merits, it is convincing. Man is infinitely more than science; science, as well as the Sabbath, was made for man. It must be remembered, also, that all sciences are not of equal importance. Tolstoy insists that the science of "How to Live" is more important than any other science, and is this not true? It is better to trust in the Rock of Ages, than to know the age of the rocks; it is better for one to know that he is close to the Heavenly Father, than to know how far the stars in the heavens are apart. And is it not just as important that the scientists who deal with matter should respect the scientists who deal with spiritual things, as that the latter should respect the former? If it be true, as Paul declares, that "the things that are seen are temporal" while "the things that are unseen are eternal," why should those who deal with temporal things think themselves superior to

those who deal with the things that are eternal? Why should the Bible, which the centuries have not been able to shake, be discarded for scientific works that have to be revised and corrected every few years? The preference should be given to the Bible.

The two lines of work are parallel. There should be no conflict between the discoverers of *real* truths, because real truths do not conflict. Every truth harmonizes with every other truth, but why should an hypothesis, suggested by a scientist, be accepted as true until its truth is established? Science should be the last to make such a demand because science to be truly science is classified knowledge; it is the explanation of facts. Tested by this definition, Darwinism is not science at all; it is guesses strung together. There is more science in the twenty-fourth verse of the first chapter of Genesis (And God said, let the earth bring forth the living creature after his kind, cattle and creeping things, and beast of the earth after his kind; and it was so.) than in all that Darwin wrote.

It is no light matter to impeach the veracity of the Scriptures in order to accept, not a truth—not even a theory—but a mere hypothesis. Professor Huxley says, "There is no fault to be found with Darwin's method, but it is another thing whether he has fulfilled all the conditions imposed by that method. Is it satisfactorily proved that species may be originated by selection? That none of the phenomena exhibited by the species are inconsistent with the origin of the species in this way? If these questions can be answered in the affirmative, Mr. Darwin's view steps out of the

ranks of hypothesis into that of theories; but so long as the evidence adduced falls short of enforcing that affirmative, so long, to our minds, the new doctrine must be content to remain among the former—an extremely valuable, and in the highest degree probable, doctrine; indeed the only extant hypothesis which is worth anything in a scientific point of view; but still a hypothesis, and not a theory of species." "After much consideration," he adds, "and assuredly with no bias against Darwin's views, it is our clear conviction that, as the evidence now stands, it is not absolutely proven that a group of animals, having all the characters exhibited by species in nature, has ever been originated by selection, whether artificial or natural."

But Darwin is absurd as well as groundless. He announces two laws, which, in his judgment, explain the development of man from the lowest form of animal life, viz., natural selection and sexual selection. The latter has been abandoned by the modern believers in evolution, but two illustrations, taken from Darwin's "Descent of Man," will show his unreliability as a guide to the young. On page 587 of the 1874 edition, he tries to explain man's superior mental strength (a proposition more difficult to defend to-day than in Darwin's time). His theory is that, "the struggle between the males for the possession of the females" helped to develop the male mind and that this superior strength was transmitted by males to their male offspring.

After having shown, to his own satisfaction, how sexual selection would account for the (supposed)

greater strength of the male mind, he turns his attention to another question, namely, how did man become a hairless animal? This he accounts for also by sexual selection—the females preferred the males with the least hair (page 624). In a footnote on page 625 he says that this view has been harshly criticized. "Hardly any view advanced in this work," he says, "has met with so much disfavour." A comment and a question: First, Unless the brute females were very different from the females as we know them, they would not have agreed in taste. Some would "probably" have preferred males with less hair, others, "we may well suppose," would have preferred males with more hair. Those with more hair would naturally be the stronger because better able to resist the weather. But, second, how could the males have strengthened their minds by fighting for the females if, at the same time, the females were breeding the hair off by selecting the males? Or, did the males select for three years and then allow the females to do the selecting during leap year?

But, worse yet, in a later edition published by L. A. Burt Company, a "supplemental note" is added to discuss two letters which he thought supported the idea that sexual selection transformed the hairy animal into the hairless man. Darwin's correspondent (page 710) reports that a mandril seemed to be proud of a bare spot. Can anything be less scientific than trying to guess what an animal is thinking about? It would seem that this also was a subject about which it was "useless to speculate."

While on this subject it may be worth while to call your attention to other fantastic imaginings of which those are guilty who reject the Bible and enter the field of speculation—fiction surpassing anything to be found in the Arabian Nights. If one accepts the Scriptural account of the creation, he can credit God with the working of miracles and with the doing of many things that man cannot understand. The evolutionist, however, having substituted what he imagines to be a universal law for separate acts of creation must explain everything. The evolutionst, not to go back farther than life just now, begins with one or a few invisible germs of life on the planet and imagines that these invisible germs have, by the operation of what they call "resident forces," unaided from without, developed into all that we see to-day. They cannot in a lifetime explain the things that have to be explained, if their hypothesis is accepted—a useless waste of time even if explanation were possible.

Take the eye, for instance; believing in the Mosaic account, I believe that God made the eyes when He made man—not only made the eyes but carved out the caverns in the skull in which they hang. It is easy for the believer in the Bible to explain the eyes, because he believes in a God who can do all things and, according to the Bible, did create man as a part of a divine plan.

But how does the evolutionist explain the eye when he leaves God out? Here is the only guess that I have seen—if you find any others I shall be glad to know of them, as I am collecting the guesses of the evolutionists. The evolutionist guesses that there was a time

when eyes were unknown—that is a necessary part of the hypothesis. And since the eye is a universal possession among living things the evolutionist guesses that it came into being—not by design or by act of God—but just happened, and how did it happen? I will give you the guess—a piece of pigment, or, as some say, a freckle appeared upon the skin of an animal that had no eyes. This piece of pigment or freckle converged the rays of the sun upon that spot and when the little animal felt the heat on that spot it turned the spot to the sun to get more heat. The increased heat irritated the skin—so the evolutionists guess, and a nerve came there and out of the nerve came the eye! Can you beat it? But this only accounts for one eye; there must have been another piece of pigment or freckle soon afterward and just in the right place in order to give the animal two eyes.

And, according to the evolutionist, there was a time when animals had no legs, and so the leg came by accident. How? Well, the guess is that a little animal without legs was wiggling along on its belly one day when it discovered a wart—it just happened so—and it was in the right place to be used to aid it in locomotion; so, it came to depend upon the wart, and use finally developed it into a leg. And then another wart and another leg, at the proper time—by accident—and accidentally in the proper place. Is it not astonishing that any person intelligent enough to teach school would talk such tommyrot to students and look serious while doing so?

And yet I read only a few weeks ago, on page 124

of a little book recently issued by a prominent New York minister, the following:

"Man has grown up in this universe gradually developing his powers and functions as responses to his environment. If he has *eyes,* so the *biologists* assure us, it is because *light waves played upon the skin* and eyes came out in answer; if he has *ears* it is because the *air waves* were there first and the ears came out to hear. Man never yet, *according to the evolutionist,* has developed any power save as a reality called it into being. There would be no fins if there were no water, no wings if there were no air, no legs if there were no land."

You see I only called your attention to forty per cent. of the absurdities; he speaks of eyes, ears, fins, wings and legs—five. I only called attention to eyes and legs—two. The evolutionist guesses himself away from God, but he only makes matters worse. How long did the "light waves" have to play on the skin before the eyes came out? The evolutionist is very deliberate; he is long on time. He would certainly give the eye thousands of years, if not millions, in which to develop; but how could he be sure that the light waves played all the time in one place or played in the same place generation after generation until the development was complete? And why did the light waves quit playing when two eyes were perfected? Why did they not keep on playing until there were eyes all over the body? Why do they not play to-day, so that we may see eyes in process of development? And if the light waves created the eyes, why did they not

create them strong enough to bear the light? Why did the light waves make eyes and then make eyelids to keep the light out of the eyes?

And so with the ears. They must have gone *in* "to hear" instead of *out,* and wasn't it lucky that they happened to go in on opposite sides of the head instead of cater-cornered or at random? Is it not easier to believe in a God who can make the eye, the ear, the fin, the wing, and the leg, as well as the light, the sound, the air, the water and the land?

There is such an abundance of ludicrous material that it is hard to resist the temptation to continue illustrations indefinitely, but a few more will be sufficient. In order that you may be prepared to ridicule these pseudo-scientists who come to you with guesses instead of facts, let me give you three recent bits of evolutionary lore.

Last November I was passing through Philadelphia and read in an afternoon paper a report of an address delivered in that city by a college professor employed in extension work. Here is an extract from the paper's account of the speech: "Evidence that early men climbed trees with their feet lies in the way we wear the heels of our shoes—more at the outside. A baby can wiggle its big toe without wiggling its other toes—an indication that it once used its big toe in climbing trees." What a consolation it must be to mothers to know that the baby is not to be blamed for wiggling the big toe without wiggling the other toes. It cannot help it, poor little thing; it is an inheritance from "the tree man," so the evolutionists tell us.

And here is another extract: "We often dream of falling. Those who fell out of the trees some fifty thousand years ago and were killed, of course, had no descendants. So those who fell and were *not* hurt, of course, lived, and so we are never hurt in our dreams of falling." Of course, if we were actually descended from the inhabitants of trees, it would seem quite likely that we descended from those that were *not* killed in falling. But they must have been badly frightened if the impression made upon their feeble minds could have lasted for fifty thousand years and still be vivid enough to scare us.

If the Bible said anything so idiotic as these guessers put forth in the name of science, scientists would have a great time ridiculing the sacred pages, but men who scoff at the recorded interpretation of dreams by Joseph and Daniel seem to be able to swallow the amusing interpretations offered by the Pennsylvania professor.

A few months ago the *Sunday School Times* quoted a professor in an Illinois University as saying that the great day in history was the day when a water puppy crawled up on the land and, deciding to be a land animal, became man's progenitor. If these scientific speculators can agree upon the day they will probably insist on our abandoning Washington's birthday, the Fourth of July, and even Christmas, in order to join with the whole world in celebrating "Water Puppy Day."

Within the last few weeks the papers published a dispatch from Paris to the effect that an "eminent

scientist" announced that he had communicated with the spirit of a dog and learned from the dog that it was happy. Must we believe this, too?

But is the law of "natural selection" a sufficient explanation, or a more satisfactory explanation, than sexual selection? It is based on the theory that where there is an advantage in any characteristic, animals that possess this characteristic survive and propagate their kind. This, according to Darwin's argument, leads to progress through the "survival of the fittest." This law or principle (natural selection), so carefully worked out by Darwin, is being given less and less weight by scientists. Darwin himself admits that he "perhaps attributed too much to the action of natural selection and the survival of the fittest" (page 76). John Burroughs, the naturalist, rejects it in a recent magazine article. The followers of Darwin are trying to retain evolution while rejecting the arguments that led Darwin to accept it as an explanation of the varied life on the planet. Some evolutionists reject Darwin's line of descent and believe that man, instead of coming from the ape, branched off from a common ancestor farther back, but "cousin" ape is as objectionable as "grandpa" ape.

While "survival of the fittest" may seem plausible when applied to individuals of the same species, it affords no explanation whatever, of the almost infinite number of creatures that have come under man's observation. To believe that natural selection, sexual selection or any other kind of selection can account for the countless differences we see about us requires more

faith in *chance* than a Christian is required to have in God.

Is it conceivable that the hawk and the humming-bird, the spider and the honey bee, the turkey gobbler and the mocking-bird, the butterfly and the eagle, the ostrich and the wren, the tree toad and the elephant, the giraffe and the kangaroo, the wolf and the lamb should all be the descendants of a common ancestor? Yet these and all other creatures must be blood relatives if man is next of kin to the monkey.

If the evolutionists are correct; if it is true that all that we see is the result of development from one or a few invisible germs of life, then, in plants as well as in animals there must be a line of descent connecting all the trees and vegetables and flowers with a common ancestry. Does it not strain the imagination to the breaking point to believe that the oak, the cedar, the pine and the palm are all the progeny of one ancient seed and that this seed was also the ancestor of wheat and corn, potato and tomato, onion and sugar beet, rose and violet, orchid and daisy, mountain flower and magnolia? Is it not more rational to believe in *God* and explain the varieties of life in terms of divine power than to waste our lives in ridiculous attempts to explain the unexplainable? There is no mortification in admitting that there are insoluble mysteries; but it is shameful to spend the time that God has given for nobler use in vain attempts to exclude God from His own universe and to find in chance a substitute for God's power and wisdom and love.

While evolution in plant life and in animal life *up to*

the highest form of animal might, if there were proof of it, be admitted without raising a presumption that would compel us to give a brute origin to man, why should we admit a thing of which there is no proof? Why should we encourage the guesses of these speculators and thus weaken our power to protest when they attempt the leap from the monkey to man? Let the evolutionist furnish his proof.

Although our chief concern is in protecting man from the demoralization involved in accepting a brute ancestry, it is better to put the advocates of evolution upon the defensive and challenge them to produce proof in support of their hypothesis in plant life and in the animal world. They will be kept so busy trying to find support for their hypothesis in the kingdoms below man that they will have little time left to combat the Word of God in respect to man's origin. Evolution joins issue with the Mosaic account of creation. God's law, as stated in Genesis, is *reproduction according to kind;* evolution implies reproduction *not* according to kind. While the process of change implied in evolution is covered up in endless eons of time it is *change* nevertheless. The Bible does not say that reproduction shall be *nearly* according to kind or *seemingly* according to kind. The statement is positive that it is *according to kind,* and that does not leave any room for the *changes* however gradual or imperceptible that are necessary to support the evolutionary hypothesis.

We see about us everywhere and always proof of the Bible law, viz., reproduction according to kind; we

find nothing in the universe to support Darwin's doctrine of reproducton other than of kind.

If you question the possibility of such changes as the Darwinian doctrine supposes you are reminded that the scientific speculators have raised the time limit. "If ten million years are not sufficient, take twenty," they say: "If fifty million years are not enough take one or two hundred millions." That accuracy is not essential in such guessing may be inferred from the fact that the estimates of the time that has elapsed since life began on the earth, vary from less than twenty-five million years to more than three hundred million. Darwin estimated this period at two hundred million years while Darwin's son estimated it at fifty-seven million.

It requires more than millions of years to account for the varieties of life that inhabit the earth; it requires a Creator, unlimited in power, unlimited intelligence, and unlimited love.

But the doctrine of evolution is sometimes carried farther than that. A short while ago Canon Barnes, of Westminster Abbey, startled his congregation by an interpretation of evolution that ran like this: "It now seems highly probable (probability again) that from some fundamental stuff in the universe the electrons arose. From them came matter. From matter, life emerged. From life came mind. From mind, spiritual consciousness was developing. There was a time when matter, life and mind, and the soul of man were not, but now they are. Each has arisen as a part of the vast scheme planned by God." (An American

professor in a Christian college has recently expressed himself along substantially the same lines.)

But what has God been doing since the "stuff" began to develop? The verbs used by Canon Barnes indicate an internal development unaided from above. "Arose, came, emerged, etc.," all exclude the idea that God is within reach or call in man's extremity.

When I was a boy in college the materialists began with matter separated into infinitely small particles and every particle separated from every other particle by distance infinitely great. But now they say that it takes 1,740 electrons to make an atom of infinite fineness. God, they insist, has not had anything to do with this universe since 1,740 electrons formed a chorus and sang, "We'll be an atom by and by."

It requires measureless credulity to enable one to believe that all that we see about us came by chance, by a series of happy-go-lucky accidents. If only an infinite God could have formed hydrogen and oxygen and united them in just the right proportions to produce water—the daily need of every living thing—scattered among the flowers all the colours of the rainbow and every variety of perfume, adjusted the mocking-bird's throat to its musical scale, and fashioned a soul for man, why should we want to imprison such a God in an impenetrable past? This is a living world; why not a *living* God upon the throne? Why not allow Him to work *now?*

Darwin is so sure that his theory is correct that he is ready to accuse the Creator of trying to deceive man if the theory is not sound. On page 41 he says: "To

take any other view is to admit that our structure and that of all animals about us, is a mere snare to entrap our judgment;" as if the Almighty were in duty bound to make each species so separate from every other that *no one* could possibly be confused by resemblances. There would seem to be differences enough. To put man in a class with the chimpanzee because of any resemblances that may be found is so unreasonable that the masses have never accepted it.

If we see houses of different size, from one room to one hundred, we do not say that the large houses grew out of small ones, but that the architect that could plan one could plan all.

But a groundless hypothesis—even an absurd one—would be unworthy of notice if it did no harm. This hypothesis, however, does incalculable harm. It teaches that Christianity impairs the race physically. That was the first implication at which I revolted. It led me to review the doctrine and reject it entirely. If hatred is the law of man's development; that is, if man has reached his present perfection by a cruel law under which the strong kill off the weak—then, if there is any logic that can bind the human mind, we must turn backward toward the brute if we dare to substitute the law of love for the law of hate. That is the conclusion that I reached and it is the conclusion that Darwin himself reached. On pages 149–50 he says: "With savages the weak in body or mind are soon eliminated; and those that survive commonly exhibit a vigorous state of health. We civilized men, on the other hand, do our utmost to check the progress of

elimination. We build asylums for the imbecile, the maimed and the sick; we institute poor laws; our medical experts exert their utmost skill to save the lives of every one to the last moment. There is reason to believe that vaccination has preserved thousands who from weak constitutions would have succumbed to smallpox. Thus the weak members of civilized societies propagate their kind. No one who has attended to the breeding of domestic animals will doubt that this must be highly injurious to the race of man."

This confession deserves analysis. First, he commends, by implication, the savage method of eliminating the weak, while, by implication, he condemns "civilized men" for prolonging the life of the weak. He even blames vaccination because it has preserved thousands who might otherwise have succumbed (for the benefit of the race?). Can you imagine anything more brutal? And then note the low level of the argument. "No one who has attended the breeding of domestic animals will doubt that this must be highly injurious to the race of man." All on a brute basis.

His hypothesis breaks down here. The minds which, according to Darwin, are developed by natural selection and sexual selection, use their power to suspend the law by which they have reached their high positions. Medicine is one of the greatest of the sciences and its chief object is to save life and strengthen the weak. That, Darwin complains, interferes with "the survival of the fittest." If he complains of vaccination, what would he say of the more

recent discovery of remedies for typhoid fever, yellow fever and the black plague? And what would he think of saving weak babies by pasteurizing milk and of the efforts to find a specific for tuberculosis and cancer? Can such a barbarous doctrine be sound?

But Darwin's doctrine is even more destructive. His heart rebels against the "hard reason" upon which his heartless hypothesis is built. He says: "The aid which we feel impelled to give to the helpless is mainly the result of the instinct of sympathy, which was originally acquired as a part of the social instincts, but subsequently rendered in the manner indicated, more tender and more widely diffused. Nor could we check our sympathy even at the urging of hard reason, without deterioration in the noblest part of our nature. The surgeon may harden himself while performing an operation, for he knows he is acting for the good of his patient; but if we were to intentionally neglect the weak and the helpless, it could be only for a contingent benefit, with overwhelming present evil. We must therefore bear the undoubted bad effects of the weak surviving and propagating their kind."

The moral nature which, according to Darwin, is also developed by natural selection and sexual selection, repudiates the brutal law to which, if his reasoning is correct, it owes its origin. Can that doctrine be accepted as scientific when its author admits that we cannot apply it "without deterioration in the noblest part of our nature"? On the contrary, civilization is measured by the moral revolt against the cruel doctrine developed by Darwin.

Darwin rightly decided to suspend his doctrine, even at the risk of impairing the race. But some of his followers are more hardened. A few years ago I read a book in which the author defended the use of alcohol on the ground that it rendered a service to society by killing off the degenerates. And this argument was advanced by a scientist in the fall of 1920 at a congress against alcohol.

The language which I have quoted proves that Darwinism is directly antagonistic to Christianity, which boasts of its eleemosynary institutions and of the care it bestows on the weak and the helpless. Darwin, by putting man on a brute basis and ignoring spiritual values, attacks the very foundations of Christianity.

Those who accept Darwin's views are in the habit of saying that it need not lessen their reverence for God to believe that the Creator fashioned a germ of life and endowed it with power to develop into what we see today. It is true that a God who could make man as he is, could have made him by the long-drawn-out process suggested by Darwin. To do either would require infinite power, beyond the ability of man to comprehend. But what is the *natural tendency* of Darwin's doctrine?

Will man's attitude toward Darwin's God be the same as it would be toward the God of Moses? Will the believer in Darwin's God be as conscious of God's presence in his daily life? Will he be as sensitive to God's will and as anxious to find out what God wants him to do?

Will the believer in Darwin's God be as fervent in prayer and as open to the reception of divine suggestions?

I shall later trace the influence of Darwinism on world peace when the doctrine is espoused by one bold enough to carry it to its logical conclusion, but I must now point out its natural and logical effect upon young Christians.

A boy is born in a Christian family; as soon as he is able to join words together into sentences his mother teaches him to lisp the child's prayer: "Now I lay me down to sleep; I pray the Lord my soul to keep; if I should die before I wake, I pray the Lord my soul to take." A little later the boy is taught the Lord's Prayer and each day he lays his petition before the Heavenly Father: "Give us this day our daily bread"; "Lead us not into temptation"; "Deliver us from evil"; "Forgive our trespasses"; etc.

He talks with God. He goes to Sunday school and learns that the Heavenly Father is even more kind than earthly parents; he hears the preacher tell how precious our lives are in the sight of God—how even a sparrow cannot fall to the ground without His notice. All his faith is built upon the Book that informs him that he is made in the image of God; that Christ came to reveal God to man and to be man's Saviour.

Then he goes to college and a learned professor leads him through a book 600 pages thick, largely devoted to resemblances between man and the beasts about him. His attention is called to a point in the ear that is like a point in the ear of the ourang, to ca-

nine teeth, to muscles like those by which a horse moves his ears.

He is then told that everything found in a human brain is found in miniature in a brute brain.

And how about morals? He is assured that the development of the moral sense can be explained on a brute basis without any act of, or aid from, God. (See pages 113–114.)

No mention of religion, the only basis for morality; not a suggestion of a sense of responsibility to God—nothing but cold, clammy materialism! Darwinism transforms the Bible into a story book and reduces Christ to man's level. It gives him an ape for an ancestor on His mother's side at least and, as many evolutionists believe, on His Father's side also.

The instructor gives the student a new family tree millions of years long, with its roots in the water (marine animals) and then sets him adrift, with infinite capacity for good or evil but with no light to guide him, no compass to direct him and no chart of the sea of life!

No wonder so large a percentage of the boys and girls who go from Sunday schools and churches to colleges (sometimes as high as seventy-five per cent.) never return to religious work. How can one feel God's presence in his daily life if Darwin's reasoning is sound? This restraining influence, more potent than any external force, is paralyzed when God is put so far away. How can one believe in prayer if, for millions of years, God has never touched a human life or laid His hand upon the destiny of the human

race? What mockery to petition or implore, if God neither hears nor answers. Elijah taunted the prophets of Baal when their god failed to answer with fire; "Cry aloud," he said, "peradventure he sleepeth." Darwin mocks the Christians even more cruelly; he tells us that our God has been asleep for millions of years. Even worse, he does not affirm that Jehovah was ever awake. Nowhere does he collect for the reader the evidences of a Creative Power and call upon man to worship and obey God. The great scientist is, if I may borrow a phrase, "too much absorbed in the things infinitely small to consider the things infinitely great." Darwinism chills the spiritual nature and quenches the fires of religious enthusiasm. If the proof in support of Darwinism does not compel acceptance—and it does not—why substitute it for an account of the Creation that links man directly with the Creator and holds before him an example to be imitated? As the eminent theologian, Charles Hodge, says: "The Scriptural doctrine (of Creation) accounts for the spiritual nature of man, and meets all his spiritual necessities. It gives him an object of adoration, love and confidence. It reveals the Being on whom his indestructible sense of responsibility terminates. The truth of this doctrine, therefore, rests not only upon the authority of the Scriptures but on the very constitution of our nature."

I have spoken of what would seem to be the natural and logical effect of the Darwin hypothesis on the minds of the young. This view is confirmed by its *actual* effect on Darwin himself. In his "Life and

Letters," he says: "I am much engaged, an old man, and out of health, and I cannot spare time to answer your questions fully—nor indeed can they be answered. Science has nothing to do with Christ, except in so far as the habit of scientific research makes a man cautious in admitting evidence. For myself, I do not believe that there ever has been any revelation. As for a future life, every man must judge for himself between conflicting vague probabilities." It will be seen that science, according to Darwin, has nothing to do with Christ (except to discredit *revelation* which makes Christ's mission known to men). Darwin himself does not believe that there has ever been *any revelation,* which, of course, excludes Christ. It will be seen also that he has no definite views on the *future life*—"every man," he says, "must judge for himself between *conflicting vague probabilities.*"

It is fair to conclude that it was *his own doctrine* that led him astray, for in the same connection (in "Life and Letters") he says that when aboard the *Beagle* he was called "orthodox and was heartily laughed at by several of the officers for quoting the Bible as an unanswerable authority on some point of morality." In the same connection he thus describes his change and his final attitude: "When thus reflecting I feel compelled to look to a First Cause, having an intelligent mind in some degree analogous to that of man; and I deserve to be called a Theist. This conclusion was strong in my mind about the time, as far as I can remember, when I wrote the 'Origin of Species'; and it is since that time that it has very

gradually, with many fluctuations, become weaker. But then arises the doubt: *Can* the mind of man, which has, as I fully believe, been developed from a mind as low as that possessed by the lowest animals, be trusted when it draws such grand conclusions?

"I cannot pretend to throw the least light on such abstruse problems. The mystery of the beginning of all things is insoluble by us; and I for one must be content to remain an Agnostic."

A careful reading of the above discloses the gradual transition wrought in Darwin himself by the unsupported hypothesis which he launched upon the world, or which he endorsed with such earnestness and industry as to impress his name upon it. He was regarded as *"orthodox"* when he was young; he was even laughed at for quoting the Bible *"as an unanswerable authority on some point of morality."* In the beginning he regarded himself as a Theist and felt compelled "to look to a First Cause, having an intelligent mind in some degree analogous to that of man."

This conclusion, he says, was strong in his mind when he wrote "The Origin of Species," but he observes that since that time this conclusion very gradually became *weaker,* and then he unconsciously brings a telling indictment against his own hypothesis. He says, *"Can the mind of man* (which, according to his belief, has been *developed from a mind as low as that possessed by the lowest animals*) *be trusted when it draws such grand conclusions?"* He first links man with the animals, and then, because of this *supposed* connection, estimates man's mind by brute standards.

Agnosticism is the natural attitude of the evolutionist. How can a brute mind comprehend spiritual things? It makes a tremendous difference what a man thinks about his origin whether he looks up or down. Who will say, after reading these words, that it is immaterial what man thinks about his origin? Who will deny that the acceptance of the Darwinian hypothesis shuts out the higher reasonings and the larger conceptions of man?

On the very brink of the grave, after he had extracted from his hypothesis all the good that there was in it and all the benefit that it could confer, he is helplessly in the dark, and "cannot pretend to throw the least light on such abstruse problems." When he believed in God, in the Bible, in Christ and in a future life there were no mysteries that disturbed him, but a *guess* with nothing in the universe to support it swept him away from his moorings and left him in his old age in the midst of mysteries that he thought *insoluble.* He must content himself with *Agnosticism.* What can Darwinism ever do to compensate any one for the destruction of faith in God, in His Word, in His Son, and of hope of immortality?

It would seem sufficient to quote Darwin against himself and to cite the confessed effect of the doctrine as a sufficient reason for rejecting it, but the situation is a very serious one and there is other evidence that should be presented.

James H. Leuba, a professor of Psychology in Bryn Mawr College, Pennsylvania, wrote a book five years ago, entitled "Belief in God and Immortality." It

was published by Sherman French & Co., of Boston, and republished by The Open Court Publishing Company of Chicago. Every Christian preacher should procure a copy of this book and it should be in the hands of every Christian layman who is anxious to aid in the defense of the Bible against its enemies. Leuba has discarded belief in a personal God and in personal immortality. He asserts that belief in a personal God and personal immortality is declining in the United States, and he furnishes proof, which, as long as it is unchallenged, seems conclusive. He takes a book containing the names of fifty-five hundred scientists—the names of practically all American scientists of prominence, he affirms—and sends them questions. Upon the answers received he asserts that *more than one-half* of the prominent scientists of the United States, those teaching Biology, Psychology, Geology and History especially, have discarded belief in a personal God and in personal immortality.

This is what the doctrine of evolution is doing for those who teach our children. They first discard the Mosaic account of man's creation, and they do it on the ground that there are no miracles. This in itself constitutes a practical repudiation of the Bible; the miracles of the Old and New Testament cannot be cut out without a mutilation that is equivalent to rejection. They reject the supernatural along with the miracle, and with the supernatural the inspiration of the Bible and the authority that rests upon inspiration. If these believers in evolution are consistent and have the courage to carry their doctrine to its logical conclusion,

they reject the virgin birth of Christ and the resurrection. They may still regard Christ as an unusual man, but they will not make much headway in converting people to Christianity, if they declare Jesus to be nothing more than a man and either a deliberate impostor or a deluded enthusiast.

The evil influence of these Materialistic, Atheistic or Agnostic professors is disclosed by further investigation made by Leuba. He questioned the students of nine representative colleges, and upon their answers declares that, while only fifteen per cent. of the freshmen have discarded the Christian religion, thirty per cent. of the juniors and that forty to forty-five per cent. of the men *graduates* have abandoned the cardinal principles of the Christian faith. Can Christians be indifferent to such statistics? Is it an immaterial thing that so large a percentage of the young men who go from Christian homes into institutions of learning should go out from these institutions with the spiritual element eliminated from their lives? What shall it profit a man if he shall gain all the learning of the schools and lose his faith in God?

To show how these evolutionists undermine the faith of students let me give you an illustration that recently came to my attention: A student in one of the largest State universities of the nation recently gave me a printed speech delivered by the president of the university, a year ago this month, to 3,500 students, and printed and circulated by the Student Christian Association of the institution. The student who gave me the speech marked the following paragraph: "And,

again, religion must not be thought of as something that is inconsistent with reasonable, scientific thinking in regard to the nature of the universe. I go so far as to say that, if you cannot reconcile religion with the things taught in biology, in psychology, or in the other fields of study in this university, then you should throw your religion away. Scientific truth is here to stay." What about the Bible, is it not here to stay? If he had stopped with the first sentence, his language might not have been construed to the injury of religion, because religion is not "inconsistent with reasonable, scientific thinking in regard to the nature of the universe." There is nothing *unreasonable* about Christianity, and there is nothing *unscientific* about Christianity. No scientific *fact*—no *fact* of any other kind can disturb religion, because *facts are not in conflict with each other.* It is *guessing* by scientists and so-called scientists that is doing the harm. And it is *guessing* that is endorsed by this distinguished college president (a D. D., too, as well as an LL. D. and a Ph. D.) when he says, "I go so far as to say that, if you cannot reconcile religion with the things taught in biology, in psychology, or in the other fields of study in this university, then you should throw your religion away." What does this mean, except that the books on biology and on other scientific subjects used in that university are to be preferred to the Bible in case of conflict? The student is told, "throw your religion away," if he cannot reconcile it (the Bible, of course,) with the things taught in biology, psychology, etc. Books on biology change constantly, likewise

books on psychology, and yet they are held before the students as better authority than the unchanging Word of God.

Is any other proof needed to show the irreligious influence exerted by Darwinism applied to man? At the University of Wisconsin (so a Methodist preacher told me) a teacher told his class that the Bible was a collection of myths. When I brought the matter to the attention of the President of the University, he criticized me but avoided all reference to the professor. At Ann Arbor a professor argued with students against religion and asserted that no thinking man could believe in God or the Bible. At Columbia (I learned this from a Baptist preacher) a professor began his course in geology by telling his class to throw away all that they had learned in the Sunday school. There is a professor in Yale of whom it is said that no one leaves his class a believer in God. (This came from a young man who told me that his brother was being led away from the Christian faith by this professor.) A father (a Congressman) tells me that a daughter on her return from Wellesley told him that nobody believed in the Bible stories now. Another father (a Congressman) tells me of a son whose faith was undermined by this doctrine in a Divinity School. Three preachers told me of having their interest in the subject aroused by the return of their children from college with their faith shaken. The Northern Baptists have recently, after a spirited contest, secured the adoption of a Confession of Faith; it was opposed by the evolutionists.

In Kentucky the fight is on among the Disciples, and it is becoming more and more acute in the Northern branches of the Methodist and Presbyterian Churches. A young preacher, just out of a theological seminary, who did not believe in the virgin birth of Christ, was recently ordained in Western New York. Last April I met a young man who was made an atheist by two teachers in a Christian college.

These are only a few illustrations that have come under my own observation—nearly all of them within a year. What is to be done? Are the members of the various Christian churches willing to have the power of the pulpit paralyzed by a false, absurd and ridiculous doctrine which is without support in the written Word of God and without support also in nature? Is "thus saith the Lord" to be supplanted by guesses and speculations and assumptions? I submit three propositions for the consideration of the Christians of the nation:

First, the preachers who are to break the bread of life to the lay members should believe that man has in him the breath of the Almighty, as the Bible declares, and not the blood of the brute, as the evolutionists affirm. He should also believe in the virgin birth of the Saviour.

Second, none but Christians in good standing and with a spiritual conception of life should be allowed to teach in Christian schools. Church schools are worse than useless if they bring students under the influence of those who do not believe in the religion upon which the Church and church schools are built. Atheism

and Agnosticism are more dangerous when hidden under the cloak of religion than when they are exposed to view.

Third, in schools supported by taxation we should have a real neutrality wherever neutrality in religion is desired. If the Bible cannot be defended in these schools it should not be attacked, either directly or under the guise of philosophy or science. The neutrality which we now have is often but a sham; it carefully excludes the Christian religion but permits the use of the schoolrooms for the destruction of faith and for the teaching of materialistic doctrines.

It is not sufficient to say that *some* believers in Darwinism retain their belief in Christianity; some survive smallpox. As we avoid smallpox because *many* die of it, so we should avoid Darwinism because it *leads many astray.*

If it is contended that an instructor has a right to teach anything he likes, I reply that the parents who pay the salary have a right to decide what shall be taught. To continue the illustration used above, a person can expose himself to the smallpox if he desires to do so, but he has no right to communicate it to others. So a man can believe anything he pleases but he has no right to teach it against the protest of his employers.

Acceptance of Darwin's doctrine tends to destroy one's belief in immortality as taught by the Bible. If there has been no break in the line between man and the beasts—no time when by the act of the Heavenly

Father man became "a living Soul," at what period in man's development was he endowed with the hope of a future life? And, if the brute theory leads to the abandonment of belief in a future life with its rewards and punishments, what stimulus to righteous living is offered in its place?

Darwinism leads to a denial of God. Nietzsche carried Darwinism to its logical conclusion and it made him the most extreme of anti-Christians. I had read extracts from his writings—enough to acquaint me with his sweeping denial of God and of the Saviour—but not enough to make me familiar with his philosophy.

As the war progressed I became more and more impressed with the conviction that the German propaganda rested upon a materialistic foundation. I secured the writings of Nietzsche and found in them a defense, made in advance, of all the cruelties and atrocities practiced by the militarists of Germany. Nietzsche tried to substitute the worship of the "Superman" for the worship of God. He not only rejected the Creator, but he rejected all moral standards. He praised war and eulogized hatred because it led to war. He denounced sympathy and pity as attributes unworthy of man. He believed that the teachings of Christ made degenerates and, logical to the end, he regarded Democracy as the refuge of weaklings. He saw in man nothing but an animal and in that animal the highest virtue he recognized was "The Will to Power"—a will which should know no let or hindrance, no restraint or limitation.

Nietzsche's philosophy would convert the world into a ferocious conflict between beasts, each brute trampling ruthlessly on everything in his way. In his book entitled "Joyful Wisdom," Nietzsche ascribes to Napoleon the very same dream of power—Europe under one sovereign and that sovereign the master of the world—that lured the Kaiser into a sea of blood from which he emerged an exile seeking security under a foreign flag. Nietzsche names Darwin as one of the three great men of his century, but tries to deprive him of credit (?) for the doctrine that bears his name by saying that Hegel made an earlier announcement of it. Nietzsche died hopelessly insane, but his philosophy has wrought the moral ruin of a multitude, if it is not actually responsible for bringing upon the world its greatest war.

His philosophy, if it is worthy the name of philosophy, is the ripened fruit of Darwinism—and a tree is known by its fruit.

In 1900—over twenty years ago—while an International Peace Congress was in session in Paris the following editorial appeared in *L'Univers:*

"The spirit of peace has fled the earth because evolution has taken possession of it. The plea for peace in past years has been inspired by faith in the divine nature and the divine origin of man; men were then looked upon as children of one Father and war, therefore, was fratricide. But now that men are looked upon as children of apes, what matters it whether they are slaughtered or not?"

I have given you above the words of a French writer

published twenty years ago. I have just found in a book recently published by a prominent English writer words along the same line, only more comprehensive. The corroding influence of Darwinism has spread as the doctrine has been increasingly accepted. In the American preface to "The Glass of Fashion" these words are to be found: "Darwinism not only justifies the sensualist at the trough and Fashion at her glass; it justifies Prussianism at the cannon's mouth and Bolshevism at the prison-door. If Darwinism be true, if Mind is to be driven out of the universe and accident accepted as a sufficient cause for all the majesty and glory of physical nature, then there is no crime or violence, however abominable in its circumstances and however cruel in its execution, which cannot be justified by success, and no triviality, no absurdity of Fashion which deserves a censure: more—there is no act of disinterested love and tenderness, no deed of self-sacrifice and mercy, no aspiration after beauty and excellence, for which a single reason can be adduced in logic."

To destroy the faith of Christians and lay the foundation for the bloodiest war in history would seem enough to condemn Darwinism, but there are still two other indictments to bring against it. First, that it is the basis of the gigantic class struggle that is now shaking society throughout the world. Both the capitalist and the labourer are increasingly class conscious. Why? Because the doctrine of the "Individual efficient for himself"—the brute doctrine of the "survival of the fittest"—is driving men into a life-and-

death struggle from which sympathy and the spirit of brotherhood are eliminated. It is transforming the industrial world into a slaughter-house.

Benjamin Kidd, in a masterful work, entitled, "The Science of Power," points out how Darwinism furnished Neitzsche with a scientific basis for his godless system of philosophy and is demoralizing industry.

He also quotes eminent English scientists to support the last charge in the indictment, namely, that Darwinism robs the reformer of hope. Its plan of operation is to improve the race by "scientific breeding" on a purely physical basis. A few hundred years may be required—possibly a few thousand—but what is time to one who carries eons in his quiver and envelopes his opponents in the "Mist of Ages"?

Kidd would substitute the "Emotion of the Ideal" for scientific breeding and thus shorten the time necessary for the triumph of a social reform. He counts one or two generations as sufficient. This is an enormous advance over Darwin's doctrine, but Christ's plan is still more encouraging. A man can be born again; the springs of life can be cleansed instantly so that the heart loves the things that it formerly hated and hates the things that it once loved. If this is true of *one*, it can be true of *any number*. Thus, a nation can be born in a day if the ideals of the people can be changed.

Many have tried to harmonize Darwinism with the Bible, but these efforts, while honest and sometimes even agonizing, have not been successful. How could they be when the natural and inevitable tendency of

Darwinism is to exalt the mind at the expense of the heart, to overestimate the reliability of the reason as compared with faith and to impair confidence in the Bible. The mind is a machine; it has no morals. It obeys its owner as willingly when he plots to kill as when he plans for service.

The Theistic evolutionist who tries to occupy a middle ground between those who accept the Bible account of creation and those who reject God entirely reminds one of a traveller in the mountains, who, having fallen half-way down a steep slope, catches hold of a frail bush. It takes so much of his strength to keep from going lower that he is useless as an aid to others. Those who have accepted evolution in the belief that it was not anti-Christian may well revise their conclusions in view of the accumulating evidence of its baneful influence.

Darwinism discredits the things that are supernatural and encourages the worship of the intellect—an idolatry as deadly to spiritual progress as the worship of images made by human hands. The injury that it does would be even greater than it is but for the moral momentum acquired by the student before he comes under the blighting influence of the doctrine.

Many instances could be cited to show how the theory that man descended from the brute has, when deliberately adopted, driven reverence from the heart and made young Christians agnostics and sometimes atheists—depriving them of the joy, and society of the service, that come from altruistic effort inspired by religion.

I have recently read of a pathetic case in point. In the Encyclopædia Americana you will find a sketch of the life of George John Romanes, from which the following extract is taken: "Romanes, George John, English scientist. In 1879 he was elected fellow of the Royal Society and in 1878 published, under the pseudonym 'Physicus,' a work entitled, 'A Candid Examination of Theism,' in which he took up a somewhat defiant atheistic position. Subsequently his views underwent considerable change; he revised the 'Candid Examination,' and, toward the close of his life, was engaged on 'A Candid Examination of Religion,' in which he returned to theistic beliefs. His notes for this work were published after his death, under the title 'Thoughts on Religion,' edited by Canon Gore. Romanes was an ardent supporter of Darwin and the evolutionists and in various works sought to extend evolutionary principles to mind, both in the lower animals and in the man. He wrote very extensively on modern biological theories."

Let me use Romanes' own language to describe the disappointing experiences of this intellectual "prodigal son." On page 180 of "Thoughts on Religion" (written, as above stated, just before his death but not published until after his demise) he says, "The views that I entertained on this subject (Plan in Revelation) when an undergraduate (*i. e.*, the ordinary orthodox views) were abandoned in the presence of the theory of Evolution."

It was the doctrine of Evolution that led him astray. He attempted to employ reason to the exclusion of

faith—with the usual result. He abandoned prayer, as he explains on pages 142 and 143: "Even the simplest act of will in regard to religion—that of prayer—has not been performed by me for at least a quarter of a century, simply because it has seemed impossible to pray, as it were, hypothetically, that, much as I have always desired to be able to pray, I cannot will the attempt. To justify myself for what my better judgment has often seemed to be essentially irrational, I have ever made sundry excuses." "Others have doubtless other difficulties, but mine is chiefly, I think, that of an undue regard to reason as against heart and will—undue, I mean, if so it be that Christianity is true, and the conditions to faith in it have been of divine ordination."

In time he tired of the husks of materialism and started back to his Father's house. It was a weary journey but as he plodded along, his appreciation of the heart's part increased until, on pages 152 and 153, he says, "It is a fact that we all feel the intellectual part of man to be 'higher' than the animal, whatever our theory of his origin. It is a fact that we all feel the moral part of man to be 'higher' than the intellectual, whatever our theory of either may be. It is also a fact that we all similarly feel the spiritual to be 'higher' than the moral, whatever our theory of religion may be. It is what we understand by man's moral, and still more his spiritual, qualities that go to constitute character. And it is astonishing how in all walks of life it is character that tells in the long run."

On page 150 he answered Huxley's attack on faith.

He says, "Huxley, in 'Lay Sermons,' says that faith has been proved a 'cardinal sin' by science. Now this is true enough of credulity, superstition, etc., and science has done no end of good in developing our ideas of method, evidence, etc. But this is all on the side of intellect. 'Faith' is not touched by such facts or considerations. And what a terrible hell science would have made of the world, if she had abolished the 'spirit of faith,' even in human relations."

In the days of his apostasy he "took it for granted," he says on page 164, "that Christianity was played out." When once his eyes were reopened he vied with Paul himself in recognizing the superior quality of love. On page 163 he quoted the eloquent lines of Bourdillon:

> The night has a thousand eyes,
> And the day but one;
> Yet the light of a whole world dies
> With the setting sun.
>
> The mind has a thousand eyes,
> And the heart but one;
> Yet the light of a whole life dies
> When love is done.

Having quoted this noble sentiment he adds: "Love is known to be all this. How great then, is Christianity, as being the religion of love, and causing men to believe both in the cause of love's supremacy and the infinity of God's love to man."

But Romanes still clung to Evolution and, so far as his book discloses, his mind would never allow his heart to commune with Darwin's far-away God, whose

creative power Romanes could not doubt but whose daily presence he could not admit without abandoning his theory.

His is a typical case, but many of the wanderers never return to the fold; they are lost sheep. If the doctrine were demonstrated to be true its acceptance would, of course, be obligatory, but how can one bring himself to assent to a series of assumptions when such a course is accompanied by such a tremendous risk of spiritual loss?

If, as it does in so many instances, it causes the student to choose Darwinism, with its intellectual delusions, and reject the Bible, with the incalculable blessings that its heart-culture brings, what minister of the Gospel or Christian professor can justify himself before the bar of conscience if, by impairing confidence in the Word of God, he wrecks human souls? All the intellectual satisfaction that Darwinism ever brought to those who have accepted it will not offset the sorrow that darkens a single life from which the brute theory of descent has shut out the sunshine of God's presence and the companionship of Christ. Here, too, we have the testimony of the distinguished scientist from whom I have been quoting. In his first book—the attack on Theism—he says: (page 29, "Thoughts on Religion") "I am not ashamed to confess that with this virtual negation of God the universe to me has lost its soul of loveliness; and, although from henceforth the precept to 'Work while it is day' will doubtless gain an intensified force from the terribly intensified meaning of the words that 'the night cometh when no man can

work,' yet when at times I think, as think at times I must, of the appalling contrast between the hallowed glory of that creed which once was mine, and the lonely mystery of existence as now I find it,—at such times I shall ever feel it impossible to avoid the sharpest pang of which my nature is susceptible."

Romanes, during his college days, came under the influence of those who worshipped the reason and this worship led him out into a starless night. Have we not a right to demand something more than *guesses, surmises,* and *hypotheses* before we exchange the "hallowed glory" of the Christian creed for "the lonely mystery of existence" as Romanes found it? Shall we at the behest of those who put the intellect above the heart endorse an unproved doctrine of descent and share responsibility for the wreckage of all that is spiritual in the lives of our young people? I refuse to have any part in such responsibility. For nearly twenty years I have gone from college to college and talked to students. Wherever I could do so I have pointed out the demoralizing influence of Darwinism. I have received thanks from many students who were perplexed by the materialistic teachings of their instructors and I have been encouraged by the approval of parents who were distressed by the visible effects of these teachings on their children.

As many believers in Darwinism are led to reject the Bible let me, by way of recapitulation, contrast that doctrine with the Bible:

Darwinism deals with nothing but life; the Bible deals with the entire universe—with its masses of

inanimate matter and with its myriads of living things, all obedient to the will of the great Law Giver.

Darwin concerns himself with only that part of man's existence which is spent on earth—while the Bible's teachings cover all of life, both here and hereafter.

Darwin begins by assuming life upon the earth; the Bible reveals the source of life and chronicles its creation.

Darwin devotes nearly all his time to man's body and to the points at which the human frame approaches in structure—though vastly different from—the brute; the Bible emphasizes man's godlike qualities and the virtues which reflect the goodness of the Heavenly Father.

Darwinism ends in self-destruction. As heretofore shown, its progress is suspended, and even defeated, by the very genius which it is supposed to develop; the Bible invites us to enter fields of inexhaustible opportunity wherein each achievement can be made a stepping-stone to greater achievements still.

Darwin's doctrine is so brutal that it shocks the moral sense—the heart recoils from it and refuses to apply the "hard reason" upon which it rests; the Bible points us to the path that grows brighter with the years.

Darwin's doctrine leads logically to war and to the worship of Nietzsche's "Superman"; the Bible tells us of the Prince of Peace and heralds the coming of the glad day when swords shall be beaten into ploughshares and when nations shall learn war no more.

Darwin's teachings drag industry down to the brute level and excite a savage struggle for selfish advantage; the Bible presents the claims of an universal brotherhood in which men will unite their efforts in the spirit of friendship.

As hope deferred maketh the heart sick, so the doctrine of Darwin benumbs altruistic effort by prolonging indefinitely the time needed for reforms; the Bible assures us of the triumph of every righteous cause, reveals to the eye of faith the invisible hosts that fight on the side of Jehovah and proclaims the swift fulfillment of God's decrees.

Darwinism puts God far away; the Bible brings God near and establishes the prayer-line of communication between the Heavenly Father and His children.

Darwinism enthrones selfishness; the Bible crowns love as the greatest force in the world.

Darwinism offers no reason for existence and presents no philosophy of life; the Bible explains why man is here and gives us a code of morals that fits into every human need.

The great need of the world to-day is to get back to God—back to a real belief in a living God—to a belief in God as Creator, Preserver and loving Heavenly Father. When one believes in a personal God and considers himself a part of God's plan he will be anxious to know God's will and to do it, seeking direction through prayer and made obedient through faith.

Man was made in the Father's image; he enters

upon the stage, the climax of Jehovah's plan. He is superior to the beasts of the field, greater than any other created thing—but a little lower than the angels. God made him for a purpose, placed before him infinite possibilities and revealed to him responsibilities commensurate with the possibilities. God beckons man upward and the Bible points the way; man can obey and travel toward perfection by the path that Christ revealed, or man can disobey and fall to a level lower, in some respects, than that of the brutes about him. Looking heavenward man can find inspiration in his lineage; looking about him he is impelled to kindness by a sense of kinship which binds him to his brothers. Mighty problems demand his attention; a world's destiny is to be determined by him. What time has he to waste in hunting for "missing links" or in searching for resemblances between his forefathers and the ape? In His Image—in this sign we conquer.

We are not progeny of the brute; we have not been forced upward by a blind pushing-power; neither have we tumbled upward by chance. It is a drawing-power—not a pushing-power—that rules the world—a power which finds its highest expression in Christ who promised: "I, if I be lifted up from the earth, will draw all men unto me."


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THE

REFUTATION OF DARWINISM;

AND THE

CONVERSE THEORY OF DEVELOPMENT;

BASED EXCLUSIVELY UPON DARWIN'S FACTS,

AND COMPRISING QUALITATIVE AND QUANTITATIVE ANALYSES OF THE PHENOMENA OF VARIATION; OF REVERSION; OF CORRELATION; OF CROSSING; OF CLOSE-INTERBREEDING; OF THE REPRODUCTION OF LOST MEMBERS; OF THE REPAIR OF INJURIES; OF THE REINTEGRATION OF TISSUE; AND OF SEXUAL AND ASEXUAL GENERATION.

BY

T. WARREN O'NEILL,

MEMBER OF THE PHILADELPHIA BAR.

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T. Warren O'Neill,
1879.

PREFACE.

ALL religious discussion has been studiously avoided in this work, and solely positive processes of discovery have been employed. The argument is founded, exclusively, upon an analysis of the facts of variation, and of selection, as those facts are presented by Mr. Darwin, in his "ORIGIN OF SPECIES," in his "ANIMALS AND PLANTS UNDER DOMESTICATION," and in his "FERTILIZATION OF ORCHIDS."

The design is to show, that the very same facts, which Darwin confesses his inability to explain, yet upon which he relies to sustain his theory, may be explained, to the advantage of every breeder, fancier, horticulturist, and agriculturist; and explained in a way which signally disproves the theory, that Man, and other species of animal, and species of plant, were evolved from lower types.

The arguments herein are all drawn from the phenomena presented by plants, and by the lower animals; it having been deemed more favorable to a temperate and unprejudiced discussion of the subject, to exclude all mention of Man,—upon the understanding, however, that such laws as may be proven to obtain with the lower organisms, must prevail (*cæteris paribus*) also with Man.

Of the cause of Variations, or improvements; of the cause of the good generally resulting from Crossing; of the cause of the evils frequently attendant upon Close-Interbreeding; of

the cause of Correlation of Growth; and of the causes of others of his many colligations of facts, Darwin asserts that he is "in profound ignorance." Their explanation, in this work, however, puts a wholly different phase upon the problem of development, from that which Darwin (by merely estimating the ratio of development of seemingly inexplicable variations) has given it; and, further, demonstratively proves that species are normally immutable; that there is, for each species, a physiologically perfect type (capable of being realized by careful selection); and that this type, although it is susceptible of modification, in countless ways, is or may be modified, only at the cost of evil results which soon lead to the sterility, lessened constitutional vigor, and consequent extinction, of the line of those individuals which have so departed from the true moulds of their respective species.

These conclusions are arrived at, simply by making a slightly different apportionment of Darwin's facts, under Darwin's principles.

Mr. Darwin has a body of facts, and a certain set of scientific factors. These facts he distributes under his several factors, conformably to a system of apportionment which leaves a residuum which, in default of ability to explain, he is unwillingly constrained to refer to such confessedly illegitimate factors, or entities, as, "an innate tendency," "spontaneous variability," "the nature and constitution of the being which varies," "some great law of nature," etc.

In this Refutation and Converse Theory, all of Darwin's facts are taken for granted, as are all of his scientific factors. These same facts, however, are differently apportioned, with but a slight variation from Darwin's mode of distribution of them; and they are relegated to the same set of factors, in

such relative quantities, as to leave no residuum of facts unexplained; and, thereby, the necessity is obviated, of any reference to such metaphysical and unscientific entities, as "innate tendency," and others, such as Darwin employs.

The result, moreover, of this mode of distribution of the same facts under the same set of principles, is (as the author conceives) to prove, unmistakably, the immutability of each species.

The advantage of the plan herein pursued, is, that no controversy, whatever, can reasonably arise, respecting either the validity of the facts employed, or the legitimacy of the principles assumed. The issue is narrowed down to the mere questions, of the soundness of the mode in which the facts are distributed, and of the significance of the results of such a manner of apportionment.

To avoid the appearance of egotism, and the circumlocution by which such effect might have been avoided, the plural pronoun has been used, instead of the more obtrusive I.

T. WARREN O'NEILL.

PHILADELPHIA, DECEMBER 20, 1879.



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CONTENTS.

PAGE.

CHAPTER I.

DARWIN'S THEORY . . 9

CHAPTER II.

DARWIN'S IGNORANCE OF THE LAW OF VARIATIONS; AND HIS FALSE ASSUMPTION OF NO LIMIT TO IMPROVEMENTS . 35

CHAPTER III.

THE VARIATIONS, OR IMPROVEMENTS, IN EACH SPECIES, LIMITED IN NUMBER AND KIND TO THE NUMBER AND KIND OF THE CHARACTERS PREVIOUSLY LOST BY SUCH SPECIES, UNDER NATURE: OR, THE LAW OF REVERSION . . . 48

CHAPTER IV.

REVERSION NOT A LAW, *Sui Generis;* BUT A DERIVATIVE LAW, ASSIMILABLE TO OTHER WELL KNOWN LAWS . 106

CHAPTER V.

THE FALLACIES OF DARWIN'S ARGUMENT FROM NATURAL SELECTION 133

CHAPTER VI.

THE SEVERAL PROCESSES OF FORMATION OF VARIETIES . 170

CHAPTER VII.

EVILS CAUSED BY A DEPARTURE FROM THE ORIGINAL TYPE OF A SPECIES; AND GOOD OCCASIONED BY A RETURN TO SUCH ORIGINAL TYPE: OR, CROSSING AND CLOSE-INTERBREEDING 194

CHAPTER VIII. PAGE.

THE CROSSING AND THE CLOSE-INTERBREEDING OF PIGEONS AND OF FOWLS 242

CHAPTER IX.

THE CROSSING AND THE CLOSE-INTERBREEDING OF PIGS . . . 280

CHAPTER X.

THE CROSSING AND CLOSE-INTERBREEDING OF HORSES, SHEEP AND CATTLE 298

CHAPTER XI.

THE CROSSING, AND THE SELF-FERTILIZATION, OF PLANTS . . 334

CHAPTER XII.

STERILITY OF HYBRIDS 408

CHAPTER XIII.

CONCLUDING REMARKS 429

THE

REFUTATION OF DARWINISM:

AND THE

CONVERSE THEORY OF DEVELOPMENT, &C.

CHAPTER I.

DARWIN'S THEORY.

TO appreciate a Refutation, it is necessary to know exactly what it is which is refuted. To meet this need, we commence by giving Darwin's theory.

Mr. Darwin's theory of the Origin of Species, as propounded in his works "*The Origin of Species*," and "*Animals and Plants Under Domestication*," is as follows:

As Mr. Darwin professes to base his theory, not upon mere speculation as to the processes which have obtained in the past, but upon obvious inferences from the actual behaviour of things in the present, and from processes now in operation under our very eyes, he takes the reader directly to the barnyard, to the garden, and to the field. Here, under domestication, the individuals of each species, display great variation and

improvement, compared with the state, in which they were, when first placed under cultivation. The phenomena, here observed, apparently imply an universal tendency to vary, which ever seems to manifest itself, under certain changes in the circumstances; that is, that while the offspring of animals and of plants, taken from the state of nature, are, in all their main characteristics or features, like their parents, they nevertheless improve, more or less, upon their parents; and vary or differ in character, to some degree, from each other. These variations, and improvements, are also transmitted to the descendants of the varying individuals, which also go on, from generation to generation, superadding to the measure of variation, first displayed. For, when a modification is acquired by any individual, the law of inheritance transmits the acquired character to the offspring.

Variation, as Darwin remarks, is everywhere seen, under domestication. Scarcely any species, or individual of any species, either animal or vegetable, has escaped this tendency. Some species, such as the Pigeon and the Fowl, display more variation and improvement than others. Some have developed many important organs not present in the same species, under nature. Other species have developed few, or no new features; yet have improved wonderfully and variedly, in the quality and size of the characteristics they possessed when first placed under domestication. The improvements, arising in some species, have been divided or apportioned among different, and widely distinct varieties. In other species, the improvements

appearing, have been developed in all of the varieties, and each of those varieties is marked solely by the high degree of development to which some one of its features has been carried. Where, in any species, all of the characters arising by variation, have been fixed and retained in each variety, with no one character extraordinarily well developed, in comparison with the others—the breeds or varieties of the species, being distinguishable from each other merely by minute differences in the size or proportion of the features developed—there results convergence of character; which is less frequently met with, than is divergence of character. An instance in point, with respect to the diversity, or divergence of character above mentioned, is the Pigeon; each of whose principal varieties, has some one feature peculiarily characteristic of it. An instance of convergence of character, which Darwin gives, is the Cow, whose varieties, or breeds, have peculiarities which are not very distinct.

Variation also results, through the loss or reduction of some characters which the species had, when taken from the state of nature. Variation, of this kind, is exemplified in the case of the tailless breeds, the earless breeds, turn-spit dogs, niata cattle (with their lips shortened) and, in the case of the "improved" Pig, whose tusks have been greatly reduced, whose bristles and hair have been well-nigh lost, whose legs have been reduced to the smallest possible size compatible with locomotion, and the front of whose head has been rendered short and concave.

While some species, under domestication, such as

the goose, the turkey, the hive-bee, &c., have not developed features, in their individuals, sufficiently marked and varied, to serve as the foundation of any very distinct varieties, a multitude of other species display modifications which form the distinguishing characters of very widely divergent breeds. Many of the modifications, or improvements, which have arisen under man's care, and which were not known to the species, when taken from the state of nature, have led to the formation of varieties, in such species, with distributed differences distinguishing them, greater even than those differences which distinguish one species from another; and, in some cases, greater even than those which mark one genus from another.

The distinction between species and varieties, should be thoroughly appreciated, by the reader, that he may understand Darwin's argument. A species is generally taken to be, that class of organisms which are known to have a common descent from some ancient progenitor, and which are capable of indefinitely-continued, fertile reproduction among each other; but which, on being crossed with individuals of another species, are either sterile, or give birth to offspring, called hybrids, which are sterile. Thus, a horse, and an ass, are taken to be distinct species. A mule, however, is a hybrid—being the result of a cross between the two species—and, as is well known, is sterile. A variety, or breed, on the other hand, is one of a class of organisms, within a species, distinguished from its fellow varieties of the same species, by the possession of some peculiar, negative or positive character; and

which is capable of indefinitely-continued, fertile reproduction, not only among its own individuals, but, peculiarly so, with the individuals of any other variety of the same species. Thus, an Arab horse, the English race horse, the dray-horse, the Shetland pony, &c., represent varieties, or breeds, of the species horse: and a Fantail, a Pouter, a Carrier, a Runt, a Barb, a Jacobin, &c., represent varieties of the Pigeon species.

The variation, modification, or improvement, occurring under domestication, Darwin represents truly, as matter of fact, to be very great. It is proved, by him, conclusively, that there is scarcely any part of the organization of any individual of any species of plant or animal, under domestication, which is not susceptible of some, and, in the majority of instances, of great modification. Even the bones, and the internal organs—the liver, the kidneys, the vertebræ, the reproductive organs, the œsophagus, the intestinal canal—have been shown to be greatly modified. Cases of increase, and of decrease in the number of the vertebræ, have been demonstrated to be of frequent occurrence. There are improvements, or variations, in the legs, in the tongue, in the eyes, in the skin, in the hair, in the feathers, in the hoofs, in the horns, in the tail, and in the wings. There are the greatest variations in the head. Even the teeth have varied greatly, in number, size, and other characters.

Modifications, most favorable, and most different, in character, have arisen, in a variety of ways, with birds of the same species; in their head, or crest feathers, in

their wing-feathers, and in their tail-feathers. In plants, by the process of bud-variation, have been known to arise, in one generation alone, nectarines from the peach, the red magnum-bonum plum from the yellow magnum-bonum; and the moss rose from the Provence rose. An astonishingly great improvement has taken place in the wild carrot, and the parsnip, which, from mere stringy roots that they were, when taken from nature, have developed into great size and delicacy. Gooseberries also have attained great size and weight: The London Gooseberry being seven and eight times the weight of the wild fruit. The fruit of one variety of the Curcurbita *pepo*, exceeds, in volume, that of another of the same species, which is less cultivated, by more than 2000 fold!

Whatever part of the plant, man values most, that part has been sure to increase surprisingly, in size, in general development, and in quality. If it be the flower, to which man attaches value, the most astonishing improvement, in that character, is seen; while the other parts show little, or no improvement. The same occurs, where it is the fruit, the leaves, or the root, which man prizes.

Varieties of the fowl, of the turkey, of the canary-bird, of the duck, and of the goose, have developed top-knots, and reversed head feathers, since they have been taken care of by man. It would be but writing, anew, Darwin's book on "*Animals and Plants under Domestication*," to record all of the great, and wonderful improvements which have arisen, within a short time, under domestication.

Varieties, or breeds, are formed, in each species, of these variations and improvements. The reader is sufficiently well acquainted with the great improvements which have occurred in the horse, in the sheep, and in cattle, not to need a detailed statement thereof. The Pigeon, however, having displayed, probably, the greatest amount of variation, and as Darwin has not only given the greatest care and attention to this species, but has also used it as the most prominent and striking subject with which to illustrate his view, that divergence of character generates distinct species from the variations of another, a more detailed account of this species, as it exists under man's fostering care, may not be needless.

The progenitor of the pigeons now under domestication, was, Darwin says, the rock pigeon, or Columba *livia;* which, when redeemed from a state of nature, had not the slightest vestige of many of the characters which now form the striking peculiarities of many of the varieties which have descended from it; and, of those characters, which it had, the development was, by no means, so great and pronounced, as is now seen in many of the varieties.

Darwin says, that so great has been the variation or improvement, with the pigeon, that there are now not less than one hundred and fifty distinct varieties, and sub-varieties, descended from this original rock pigeon! The wing feathers, head feathers, and tail feathers, in several varieties, have been greatly changed in character and size. The well known, well marked, upwardly expanded tail, which characterizes the variety,

known as the Fantail, has been developed, since the bird was taken from a state of nature. The œsophagus has attained an enormous size, in the Pouter. A surprisingly large beak marks the Carrier. A great quantity of eye wattle has arisen, and now adorns the Barb. Divergent, and large feathers, along the front of the neck and breast, have appeared, where not even a ruffled feather was discernible before, and distinguish the Turbit. The Jacobin has the feathers so much reversed, along the back of the neck, that they form a hood. These feathers, also, are absent in the common bird, as found under nature. Other varieties have, proportionally to their size, much elongated, or much shortened, heads, necks, legs, tails, wings, bodies; and the proportions of the several characters, have been so much varied, that almost every possible ratio of the development of the species' characters, is to be found among the several varieties. As in the case of other animals, even the bones, and the internal organs, have experienced a marked change in size, number, and other characters.

So great, in fact, has been the range of variation, in this species, that, as Darwin truly remarks, a naturalist, did he not know of the community of descent of these varieties, would be induced to esteem many of them, as distinct species, and a few of them, as even distinct genera.

Judging merely by structural differences, and ignoring the physiological effect which the development or reduction of a character, has upon organisms, there are many other varieties, under domestication, which

should be regarded as distinct species; and, perhaps, others which a person, so judging, would be not too bold in accounting as belonging to different genera. The argument of Darwin is,

"How possibly can there be fixed species, or immutable species, when the individuals, which represent those species, vary and change so greatly? A species is made up of individuals; and, when those individuals change, the species, also, must necessarily change."

And, again, he argues, if difference in structural build is what alone constitutes the distinction between species, why, then, should not the great differences in structural build, between varieties of what has heretofore been known, or taken, to be one species, be taken as specific distinctions?

Having detailed, at large, these facts of variation, from which Darwin purposes to deduce his theory, the necessity of some inquiry into the natural forces at work in inducing these improvements, occurred to Darwin. Some aspect of these variations—either founded upon a scientific analysis of the phenomena, or, else, gratuitously assumed—had necessarily to be taken for granted, as a basis for further research. The question, for instance, whether these variations are amenable to any limit; the question, too, whether it be legitimate to estimate the amount of improvement possible to occur in millions of years, by means of these variations, from the amount of development known to have taken place during the last one hundred years; could not be resolved, unless some view was taken. Darwin admits—aye, explicitly states—that he has not

made such an analysis; but that he has gratuitously assumed a view, the sole warrant of which, is, he urges, that there is no reasonable, opposing view. He candidly admits that he has made no scientific induction from the facts. He contents himself with the fact alone that these improvements do arise. Conscious, that such a treatment of this subject, at the very inception of his problem, is practically to limit all inquiry at the point where the principles of the inductive philosophy especially require an analysis, he concedes that there must be a law governing them, but that it is seemingly inscrutable; and, all that he can say, on the subject, is, that the reason animals and plants vary, or improve, is because they are possessed of "an innate tendency to vary," or because of a "spontaneous variability!" though this, he admits, "is wholly incorrect, and only serves to show our ignorance of the cause of each particular variation."

In science, in law, in the every day affairs of life, it is fair to presume that, in the absence of all evidence, or other presumption to the contrary, anything which occurs regularly, or at frequent intervals, will ever continue so to recur. This presumption is a valid one, always, if all the preceding points in the problem, of which this presumption enters as an element, have been resolved. If, however, there be an *hiatus* in the chain of reasoning, anterior to the employment of this presumption that things will ever continue as they have been, the presumption is manifestly invalid. In Darwin's problem, he would be fairly entitled to the presumption, that, as variations have ever been occurring, under

domestication, they will ever so occur, *if he had resolved the question of the law of variation, and the law were silent on the subject of a limit.*

Darwin, however, takes the fact, viz., that variations do occur, and have occurred, in the past; and holds from this, that he is entitled to the presumption, that these variations will go on forever, or, at least, indefinitely. He reverses the usual canons of logic; appeals to his ignorance (!) of any law of variations; and, hence, to the absence of any such law, imposing a limit to such variations; and complacently assumes, therefore, that there is no limit to variations. He turns the logician's gun against the logician, albeit, most absurdly; and with charming simplicity, declares that the assumption of any such limit is wholly gratuitous —oblivious to the fact that, in the absence of knowledge of the law of variation, his assumption of no-limit is both illegitimate and gratuitous. Variation is ever occurring, now, with all the animals and plants under domestication; and, therefore, the presumption (Darwin holds) is a fair one, that in default of proof to the contrary, those variations ever will occur. What evidence, he triumphantly demands, is there to induce a belief that there is a limit?

Such proof to the contrary, it is the purpose of this work to advance; and full warrant for the belief that there is such a limit, we shall adduce.

It is clear to the reader, that, if there is a law of variation, and it should prescribe a limit, it is happily for Darwin, and for his theory, that his "ignorance of the law of variation" is so "profound."

Darwin, availing himself thus of the presumption of no-limit (which, other things legitimate would be itself legitimate) takes the fact, that, during a short period under domestication, most numerous and important improvements have sprung up, in animals and plants; and he concludes therefrom, that the species are not immutable; that varieties are but incipient species; that each and every species changes, with the changes in the individuals of which it is composed; and that, given a sufficient length of time—he intimates several millions of generations—it is quite probable, that, at the same (or even greatly less) rate of improvement now displayed under our very eyes, the higher forms will go on progressing, and improving, into still higher forms; and that the lower forms will develop into the higher forms: And that, as these changes of structure, occurring now with each individual, are accumulated, and made to form divergent varieties within each species; each variety of such species will further diverge into species, distinct from the parent species; and evolve, also, into other genera, families and orders.

In other words, he concludes, from the progress made with domesticated animals, that a variety of the Duck species, for example, will diverge into several distinct types, as high in the order of beings, as the Fowl, the Goose, the Turkey, the Peacock, the Condor, and the Eagle; and, that, there would be nothing impossible, but rather probable, in the circumstance of, another variety of the Duck diverging, successively, into the Bat, the Flying-Squirrel, the Rabbit, the Pig,

the Cow, the Horse, the Tiger, the inevitable Monkey, and into Man!

This is his conclusion, from the facts of variation, under domestication. This is his reasoning, viz., given, the amount of improvement observed to occur during the last hundred years; and, given, the preservation and accumulation of these variations by Man's Selection, the evolution of any of the lower forms, into any of the higher, is to be considered highly probable, and consistent with all of the analogies of science.

There is no question, with a scientist, that, if his reasoning holds good with the lower animals, it obtains equally well with Man.

Darwin now draws an analogy, between animals and plants under domestication, and all organisms under nature. He declares, and adduces some evidence in support of his statement, that variations occur, also, under nature. As then, he argues, it is possible for such great advances in development, to take place in the future, with respect to the domesticated organisms; so, it is likewise possible, and probable, that Nature has, in the past, brought about similar results; and that such a progression, from simplicity to complexity of structure, has been gradually going on, in the past under nature, by means of accumulated variations, as to have evolved the higher animals (including Man) from the simplest type of structure; or in Darwin's own words, "that all the organic beings which have lived on this earth, have descended from some one primordial form into which life was first breathed."

It is here, at this point, that Darwin anticipates an

objection which was possible to be made to his theory of development. His success in obviating this objection, constitutes his chief claim to the wide reputation he now enjoys.

It was apparent, that, under nature, and even under domestication, variability might be frequently displayed; yet, if the varying individuals were not, in some way, especially favored; if there were no process or care employed to fix, and preserve these slight appreciable variations, as they arose, and render them permanent; the variations would appear, perhaps, in individuals; but, if those individuals had not a better chance, than others, of leaving offspring; or, if they intercrossed with others displaying different modifications, or none; the variations most probably would not be transmitted, nor would any increase in such modification, or any divergence of character, result. Under domestication, such a process, and such a care, is well known to obtain. This process is Selection by Man. To this we are greatly indebted, for the great amount of improvement, observable in our domestic animals and plants. By this, the favorable modifications which arise (genenally in very small increments of growth), are preserved and accumulated; and, by this means, is the great divergence of character effected, in the varieties of many different species. The modifications, under domestication, are carefully looked for; and, when they arise, are distributed to the different varieties of the given species. Those varieties, which present such marked divergence of character, within certain species, result from man's careful selection of those

individuals presenting any modification, or improvement; and from Man's judicious pairing of such individuals, with others with like variations. In this way, the "tendency to vary," by being combined in pairs which similarly vary, is strengthened, and fixed; and an increase in the quality and quantity of the modifications, is insured in the offspring.

By this preservation, and accumulation, of slight, successive, scarcely appreciable modifications, most distinct varieties are formed; and great differences result, between the individuals of the same species. Whereas, if Man's intervention did not interpose, the individuals of each of these species would all be of one, uniform character; and the improvements which did arise, would be sunk again, by the varying individuals' intercrossing with others, of the same species, which had no like tendency to vary, or which had tendencies of growth, perhaps, adverse to the continued development of the said improvements. Under domestication, however, the individuals, similarly varying, are interbred. Favorable changes are noted by the breeder, or fancier; carefully preserved; and further developed, by the mating of such individuals, with others displaying a tendency to a like change of character. The individuals, which display no variation, or which develop changes, or variations, which are not the recognized peculiarities of their varieties, are neglected or suppressed. If this process of Man's selection were not employed, those individuals, not varying, being in the majority, would most probably run out the varying ones, or completely negative, or nullify, the tendency to vary, in others, by

intercrossing with them. Further: even if the "tendency to vary" held its own, the species would probably go on varying in one, only, line of growth. All the features which now distinguish the different varieties, would be suffered to develop themselves in each and every variety, or individual; and no diversity of character, such as is requisite to explain the great diversity of forms under nature, would be displayed; as it now is, through means of Man's selection. Darwin requires such divergence of character, in order to prove the evolution of distinct species, one from another. Convergence of character, however, would result, in the absence of Selection; and the only effect of development would be to produce, simply, a graduated series of developments, from his first primordial form. When, however, under domestication, each new character is developed, it is allotted by the breeder or fancier, to a certain variety, of which it is to form the distinguishing characteristic. In each variety, therefore, especial and exclusive attention is given to the development of the character which constitutes the peculiarity, and the other features which appear, are made to form the peculiarities of the other varieties. In this way, by not suffering all the characters which may arise, to become developed in every individual or variety, but by apportioning these characters among the several varieties of the species, is the required divergence of character effected; and, thus, each variety becomes (as Darwin fancies), a point of divergence, from which similar, multiplied divergences will also arise, from increased variations, which again will be apportioned or distributed.

Thus, when any individual of the species, Pigeon, displays the variation of the upwardly expanded tail, it is then allotted to a variety, called the Fantail variety; and suffered to be developed in that variety only. All attempts, which individuals, of the other varieties, may make to develop this feature, are discouraged; and all attempts, which any individuals, of this Fantail variety, may make to develop any of the peculiarities of the other varieties, are likewise baffled by the fancier. Again; when an enlargement of the œsophagus appears, it is allotted to the Pouter variety of the Pigeon; and a similar policy of repression of erratic individuals, is pursued. Individuals, presenting very long beaks, are allotted to the Carrier variety. The divergent feathers, along the front of the neck, and on the breast, are developed in the Turbit only; quantity of eye-wattle, in the Barb; and, reversed feathers, along the back of the head, and on the neck, forming a hood, in the Jacobin. Should any individual, of any one of these varieties, evince an inclination to take upon itself the peculiarity of any one of the other varieties, that individual the fancier remorselessly and systematically suppresses; because the standard of character, for each variety, must be maintained. By the careful mating of those individuals, of a variety, which develop the peculiarity of their variety, and which also display no disposition to superadd the peculiarities of other varieties, is this great divergence of character effected, upon which Darwin relies to show that these varieties are but incipient species, and that they diverge by different lines of growth into dis-

tinct species. Occasionally, when any individuals of any variety, develop some new feature, not known to any of the other varieties, they are taken from the variety within which they have been before classed, and placed within a new category, or variety, carefully mated, and the accretions of growth, in the new direction, thereby preserved, accumulated, and fixed to a certain persistency of type.

In this way, by Man's care and selection, has been occasioned, and rendered possible, the great amount of variation, which domestication has to show; as, also, the great divergence of character there seen. To Darwin's course, in pursuing the analogy of variation into the domain of nature, objection would have been taken; for, as it would have been said, even if variations did take place under nature, the improvements could not have gone on accumulating to any extent, or effecting any great divergence of character; by reason of the fact, that these results have been attained, under domestication, only because Man's selection has guided and fostered the irregular, and feeble action of variation.

To this, Darwin rejoins, by stating that there is, and has been, in full and constant operation, under nature, a process precisely analogous to Man's selection—a process to the full as efficient, and quite competent (given, a requisite allowance of time) to effect similar, great results. This process is Darwin's much-vaunted principle of Natural Selection.

This Natural Selection, or power of nature to select the best of the individuals, of any species, for purposes

of breeding, Darwin infers from the Struggle for Existence which, he says, is, under nature, constantly carried on, by all organisms, each with the others; whereby the weak succumb, and those which are the fittest, strongest, and most vigorous survive. Besides the selection of those which are the strongest, there will also be a selection of those which display some new modification; and these mating with their fellow victors in the struggle for life, will attain, through their offspring, to a higher and still higher development. Conformably to the theory of Malthus, he contends, that, under nature, the production of new organisms far outruns the means of their subsistence; that all Nature is at war, one species with another, and the individuals of the same species with each other. The result of this Struggle for Existence, is Natural Selection; by which, the lucky and the stronger prevail, and the weaker and ill-favored perish. As many more individuals are born than can possibly survive, those individuals which possess any variation which contributes to give them an advantage in this warfare, are, in the main, more likely to survive, to propagate, and to occupy the places of their weaker brethren, with their offspring. If but a single variation occurred once in a thousand generations, says Darwin; and that variation were preserved by Natural Selection, until, at the end of another thousand of generations, another variation was superadded, the improvement and diversity of the species would, eventually, be such as to occasion a divergence, by the different individuals favored, into distinct species.

The question of the origination of these improvements, or variations (which are modestly assumed to occur but once in a thousand generations), is equally left unresolved by Darwin, and referred, as are the variations under domestication, to "an innate tendency to vary," or to "spontaneous variability!"

It is impossible to deny, that there is such a Struggle for Existence, as Darwin pictures; and, equally impossible to deny, that there is some such process as Natural Selection, in operation under nature, favoring at times the preservation of the strongest and most fitted. It is scarcely possible, even, to read Darwin's graphic description of the Struggle for Existence, among animals and plants, under nature, and not marvel that any survived. Under nature, he says, organisms are subjected to the greatest vicissitudes, and to the severest competition with their fellows, with other species, and with the adverse conditions of nature. They all enter into competition, for the means of subsistence. All, almost without exception, he says, have to struggle against the hard conditions of life, and against their competitors, from the moment of their birth, to the hour of their death. He alleges, that there is no exception to the rule, that every organic being naturally increases at so high a rate that, if numbers were not destroyed, the earth would soon be covered with the progeny of a single pair. The struggle, he holds, will almost invariably be the most severe, between the individuals of the same species; for, they frequent the same districts, require the same food, and are exposed to the same dangers. Consequent upon

the astonishingly great increase, is the Natural Extinction of large numbers.

Those whom nature exempts from this wholesale destruction, are naturally those which are the fittest to live, the strongest, and most vigorous; and, notably, those who "at intervals of a thousand generations" or so, have developed some character, or modification, which gives them an advantage, in the general contest for life, over their competitors, and over the hard conditions of life.

This selection, of the strongest and fittest, and of the favorably modified organisms, as the ones of the number ordained to live, is what constitutes Darwin's Natural Selection—a factor which depends necessarily upon this Struggle for Existence.

Natural Selection has nothing whatever to do, Darwin says, with the production, or appearance, of any of the variations or improvements. How any favorable modification, or variation, comes to present itself, Darwin insists that he is profoundly ignorant. But, after the variation has appeared, this Natural Selection merely preserves it, insures its transmission to offspring, and so accumulates successive variations which arise, independently of it, owing to "an innate tendency." Natural Selection, Darwin says, does not at all cause the variations which may occur. Their origin is inexplicable to him, he says; but, "it acts exclusively by the preservation and accumulation of those variations after they have arisen." Variations occur in some strange way, by "accident or chance," independently of Natural Selection, though so to refer them to acci-

dent or chance, is, he says, merely to express our ignorance of the law. Natural Selection but preserves and accumulates the variations as they arise, and directs them into favorable lines of growth. "As all the individuals of each district are struggling together with nicely balanced forces, extremely slight modifications in the structure or habits of one individual often give it an advantage over the others." And (what is part of the same Natural Selection, called Sexual Selection), were the individual varying, a male, the acquired modification would doubtless give it an advantage, in a contest for the most favored, and, perhaps, similarly varying, females; and, thereby, the modification acquired, would be the more surely impressed upon the offspring. In "several thousand generations," or a "million of generations," one of the descendants of this offspring would, probably, also vary, adding thus another character to the complexity of its structure.

As, under domestication, Man's care and choice of those animals and plants, displaying some improvement, tends to the preservation and accumulation of the characters presenting themselves, and assures the transmission of those characters to offspring; so, this Selection by Nature, of the favorably modified animals and plants, as among those which are suffered to survive and propagate their kind, represents the same principle.

"Can it be thought improbable," says Darwin, "seeing that variations useful to man, have undoubtedly occurred, that other variations, useful in some way to each being in the great and complex battle of life,

should sometimes occur in the course of thousands of generations? If such variations do occur, can we doubt (remembering that many more individuals are born than can possibly survive), that individuals, having an advantage, however slight, over others, would have the best chance of surviving and procreating their kind?" "If," he continues, "a man can, by patience, select variations useful to him, why, under changing and complex conditions of life, should not variations, useful to nature's living products, often arise and be preserved and selected?"

Darwin asks, "What limit can be put to this power, acting during long ages, and rigidly scrutinizing the whole constitution, structure, and habits of each creature—favoring the good and rejecting the bad?" "I can see no limit to this power, in slowly and beautifully adapting each form to the most complex relations of life."

"Selection," continues Darwin, "will pick out, with unerring skill, each improvement. Let this process go on for millions of years, and may we not have a low primordial type" continuing to evolve into higher and still higher forms of life, until, at last, as the result of this "innate tendency to vary," producing improvements, and of this Natural Selection preserving these improvements, all of the higher animals, including Man, are successively evolved, by the gradual operation of strictly natural processes? In this way, Darwin contends, the present development, and diversity of structure, of the several species, have been effected; and in this way "some one low primordial form into

which life was first breathed," and its descendants, have been gradually and variously developed, and differentiated, through all intervening species, into the monkey, and thence, by an easy transition, into Man!

The above is a fair statement of Darwin's theory. Condensed, it may be thus stated: Variations, or improvements, or slight, successive advances from simplicity to greater complexity of structure, have, owing to an "innate tendency to vary," occurred with animals and plants, under domestication. Similar, inexplicable modifications may have occurred (and some warrant for this assumption is furnished) with animals and plants, in the state of nature. Under domestication, Man's Selection has so accumulated, and directed these variations or improvements, that, at the same rate of progression from simplicity to complexity of structure, the higher species may continue to improve indefinitely, and each of the lower species may continue to improve into other species, genera, families and orders, as high as the highest in the existing scale of development. By analogy with domestication, the same progression, or evolution, may be said to have occurred in the past under nature; and it is possible, if not probable, that man, and all other animals, have evolved, by means of these inexplicable variations, and with the aid of the process of Natural Selection, from the lowest type of organic structure.

There is—dove-tailed within this theory of the evolution of the species—another theory with which Darwin supplements his main argument. It is, that, besides an advance in development, by means of the

slight successive, positive variation, there has been a prodigious amount of degeneration, during the past, under nature. Natural Selection has very frequently simplified and degraded the structure of animals and plants.

So widespread, Darwin says, has been this degeneration, under nature, that there exists now scarcely a single species which has not lost some organs or features.

From changed habits of life, and from the hard conditions of the Struggle for Existence—which needs must be excessively vigorous to give play to Natural Selection—organs, he says, have become of less and less use, and ultimately superfluous; and disuse, and Natural Extinction, acting on the individuals, have gone on reducing the organs, until, finally, they have either become wholly suppressed, leaving not a vestige of their existence (save the power of reappearing which, he says, they are ever competent to do, even after having lain latent for millions of generations); or, they have become only greatly reduced, having the character of rudiments.

With respect to this power of Reversion, in the many long-lost characters; he says, that characters, proper to both sexes, to both the right and left side of the body, and to a long line of male and female ancestors, separated by hundreds, or even thousands of generations from the present time, frequently lie latent in many individuals, without our being able to detect any signs of their presence; yet that "these characters, like those written on paper with invisible ink, all lie"

ever "ready to be evolved, under certain known, or unknown conditions;" and, of the many variations which he adduces, fully nine-tenths are by him explicitly referred to the mere re-appearance of these long lost characters. Of the cause of the appearance of the other tithe, he says that he is in "profound ignorance."

CHAPTER II.

Darwin's Ignorance of the Law of Variations; and his False Assumption of no Limit to Improvements.

After Darwin had adduced his facts, of the improvements among animals and plants, the next step which it behooved him to take, before he assumed that there was no-limit to such improvements, was to generalize those facts; to develop their cause; to discover the law, governing the appearance of the variations; and to ascertain, whether such law fixed a limit to such variations, or was silent on the subject. If, when discovered, the law assigned a limit to the improvements in each species, then, manifestly, no theory of the indefinite accumulation of such variations, would be possible. If, however, the law, when resolved, were to imply that such variations were possible to be carried on to an unlimited extent; or, even if the law were silent on the subject; no exception to the principal postulate of Darwinism (viz., unlimited improvement) could be taken.

But, while the cause, or law, of the improvements, remained unresolved, it was evident, that any theory, based upon such improvements, must needs be illegitimate; not necessarily false, but illegitimate, inasmuch as the assumption of a limit, or the assumption of

no-limit, in any theory, would be not only gratuitous, but also in plain derogation of that canon of the inductive philosophy, which enjoins that no principle whatever shall be reasoned from, until it first shall have been reasoned to.

The question, therefore, of the cause, or law of the improvements, is the point where Darwin's claim to the title of a Baconian philosopher should have been made good. A theory, which is to illustrate the signal triumph which "modern thought" has achieved over the ignorance of nineteen centuries, should stand upon a principle, which is as a buttress of adamant, against every assault,—not upon a gratuitous assumption formulated in the teeth of the fact that the law of its data, is yet unresolved; and despite the circumstance (which we shall develop most clearly), that those data conclusively negative such assumption.

What is the law of Variation? What is the cause of the improvements?

Darwin says, the reason that animals and plants vary, and improve, is because they possess "*an innate tendency*" to vary and improve!

This assumption of his, is a barren, metaphysical entity, which, by the concurring testimony of every inductive philosopher, from the time of Bacon down to the present, suffices to vitiate, and wholly invalidate every hypothesis in which it is present. In his "*Animals and Plants under Domestication*," and in his "*Origin of Species*," he generalizes, and explains (!) the facts of variation, by ascribing them to "an innate, tendency," to "spontaneous or accidental variability,"

to "an innate tendency," to "the nature and constitution of the being which varies," and, in numerous other portions of his works, to the same "innate tendency," variedly paraphrased.

This is the way in which Darwin resolves the problem of the cause, or law, of improvements, in order to see whether they are amenable, or not, to any limit. This is the manner in which Darwinism stands the test of the principal canon of the inductive philosophy. This "innate tendency" it is, which serves for a foundation stone to his theory;—a foundation upon which every subsequent assumption and deduction of his, depends for its strength and validity. This is the outcome of his peculiar, inductive reasoning: Animals and Plants vary, because they have an innate tendency to vary! A miserable, farcical assumption, which is naught but a restatement of the phenomena to be explained. The foundation of a theory, such as Darwin's, fraught as it would be, if true, with consequences of such moment, ought to be as incontestably established, as the most positive principle within the realm of science. It is not the mere failure to account for phenomena, to which exception is taken. Such failure may well characterize any fair and legitimate hypothesis or theory. But, it is the failure, the signal and avowed failure, to account for phenomena which lie at the very start of the inquiry, and upon which the whole of the superstructure rests for support. Before men should be asked to forswear their past impression of the descent of Man, and required to admit (under pain of ostracism from the ranks of the

learned and scientific), that their derivation is as Darwin would have it, they, beyond question, are entitled to have the ground alleged in support of such an hypothesis, formed of something more substantial than such flimsy material as an "innate tendency." Even though the consequences of the theory were comparatively of no moment whatever, it might well be required in the name of science, and of common sense, that the base of the theory—the base especially —should present at least some semblance of solidity. Most assuredly—even though there were no law, yet discovered, which governed the facts of variation, and though there were no converse theory deducible from that law—Darwin would be bound to find a law of variation, or frame some legitimate induction, before he could rightly mount one step higher in his theory.

It is not, merely, because there is a known, scientific law governing variations, nor because there is a converse theory of development, resting on that law, that Darwin's passing by the facts of variations, with a mere ascription of them to "an innate tendency," is to be deemed unscientific and illegitimate. Those are reasons, to the treatment of which we have not yet come. They are over and beyond the point of the intrinsic illegitimacy of Darwin's first assumption. Darwin's process would be unscientific, and Darwin's theory would be wholly illegitimate, if there were no explanation, of variation, known; and, if science gave, at present, not the faintest glimmering of a promise of one. It may be demurred, that the foundation of Darwin's theory is found in the facts of variation.

Not to quibble and say that the facts and the theory are altogether two different things; it may be admitted, that the facts are a foundation; but, between those facts and Darwin's theory, there is no connection, no intervening support for the superstructure of the theory. A wide hiatus yawns between.

The inductive method, of which Darwin's theory has been lauded to the skies, as the bright exemplar, has, in this ascription of the facts of variation, to an "innate tendency," been ruthlessly violated. That method forbids any principle to be taken for granted (save in a merely tentative hypothesis, avowedly tentative): or assumed at all, unless it represents truly the resolution of the unknown into the known. Thus, had Darwin conceived some law which he fancied governed variations, he might, tentatively only, have assumed it, though the evidence in support of it were very inadequate. But, merely to formulate his ignorance, in some set expression, as he has done, is grossly illegitimate, and never tolerated, when the canons of science are held in any esteem. Had his "innate tendency," not been a mere formula for his ignorance, but a hypothesis; to reason downwards, from such an assumption, which had not withstood all the tests of induction, would have been to violate the very spirit and letter of the scientific method. This method will concede nothing, but insists upon first reasoning upwards; and scoffs at the idea that any theory can be scientific, when based upon a principle which has not complied with the requirements of proof. Yet, Darwin violates all science, by perpetrating something

infinitely worse: He reasons downwards from his ignorance! which, avowedly, is the first term in his theory.

He says that he does not know the cause of variations—the law to which his data conform! He, further, tacitly deprecates all inquiry into the legitimacy of his methods, and requires that all should accept his metaphysical formula of confessed ignorance, as matter of necessary belief. Such devices, the advocates of the scientific method say, they leave to tricky metaphysicians, with which to beguile the ignorant and superstitious. Yet, this vaunted champion of the inductive method, confesses that his first assumption (or apology therefor) in a theory which essays to revolutionize all preconceived ideas of the origin and dignity of the human race, cannot satisfy the requirements of inductive or scientific thought; but, that he is constrained, at the very outset of such theory, to deal with his subject on transcendental grounds only. He himself tacitly concedes, in a mild deprecating way, that the very base of his theory is sapped, if any one be so unkind as to take exception to his first assumption of ignorance; and intimates, in a mode little short of explicit expression (aye, directly states) that the sole strength of his theory lies in an assumed agreement between his deductions from this principle of ignorance, and the phenomena in hand. You may read between the lines that he hopes this fancied agreement may atone for his gross violation, at the start, of the canons of science.

We say fancied agreement; and such it is. For, he,

in illustrating the many phenomena of variation, has adduced a multitude of facts, showing reversion, correlation, crossing, close interbreeding, reproduction, and generation; yet the reader, the breeder, the fancier, the horticulturist, the agriculturist will look in vain to find any one of the facts under either of these heads, explained, or the law of their operation resolved. His theory is confessedly incompetent to explain any of the facts, while numbers of them are irreconcilably at variance with his theory. The sum of his knowledge of them all and each is that they are "peculiar." The facts of variation are "peculiar." The facts of crossing are "peculiar." The facts of close interbreeding are "peculiar," the facts of correlation are "peculiar," and the facts of generation are "peculiar."

On page 327, *Origin of Species*, he says:

"How ignorant we are of the precise causes of sterility:" and, again, "in the presence of all the phenomena" (of crossing and close interbreeding) "we must feel how ignorant we are, and how little likely it is that we should understand why certain forms are fertile, and other forms are sterile when crossed." On p. 330, he speaks of "how entirely ignorant we are on the causes of both fertility and sterility." And of the phenomena of Correlation, he says, "this is a very important subject" (p. 170, *Origin of Species*) "most imperfectly understood." And "the nature of the bond of Correlation" (p. 171, *Origin of Species*) "is very frequently quite obscure."

On p. 231, Vol. 2, he says, of the phenomena of Crossing and close interbreeding:

"We are far from precisely knowing the cause; nor

is this surprising seeing how profoundly ignorant we are in regard to the normal and abnormal action of the reproductive organs."

He might, with equal propriety, say (and actually does say it), "seeing how profoundly ignorant" he is, respecting every one of the 100,000 facts of which he treats—how profoundly ignorant he is of variation, of reversion, of correlation, of crossing, &c. His ignorance of the cause of crossing, and of close interbreeding, is not near so surprising as is his temerity, in endeavoring to teach breeders that they are only well developed ourang outangs, when he confesses he cannot inform them of the cause of any of the phenomena with which they are meeting every day of their lives.

His inability, however, to explain these facts, does not necessarily vitiate his theory, as does his inability to give the explanation, or the law, of variation. For in the former case, he simply knows not how to explain the facts; but, in the latter case, he is ignorant of the law to which his data conform. He appears, throughout his works, to plead most pathetically with his readers (and all who are conversant with science, and with his theory, know full well that he has ample occasion to do so), to be so kind as not to be too exacting at the start; and kindly to shut their eyes to the circumstance that he is reasoning, not *to* a first principle, but *from* his ignorance! He also appears to plead with his readers to be considerately blind to the circumstance, that, in default of any resolution of the law of variations, he is is not entitled to the presumption that they go on forever.

He actually endeavors to make a potent factor out of his own ignorance. For, he appeals to his ignorance of any law of variation (therefore, of any law imposing a limit to variation), in justification of his gratuitous assumption of No Limit to Variation.

We do not wish to be understood, as alleging that Darwin, when he assumes this occult quality, this mysterious force which manifests itself in the organism which varies, or this "innate tendency," really affects to explain the phenomena by means of such entity. He confesses (how frankly, we do not know) that this "innate tendency" is the mere symbol of his ignorance of the cause, or law of variation. He stops, for a moment, occasionally to meet the inquiry, of what is the cause of these improvements which arise, and says:

"We can only attribute them to spontaneous or accidental variability, or as due to chance. This, however, is a supposition wholly incorrect and only serves to indicate plainly our ignorance of the cause of each particular variation."

Again, he says (p. 195, *Origin of Species*):

"Our ignorance of the law of variation is profound." "Not in one case out of a hundred can we pretend to assign any reason why this or that differs, more or less, from the same part in the parent."

Again, he says (p. 157, *Origin of Species*):

"I have hitherto sometimes spoken as if the variations—so common and multiform in organic beings under domestication, and, in a lesser degree, in those in a state of nature—had been due to chance. This, of course, is a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of

each particular variation. * * * Why because the reproductive system is disturbed, this or that part should vary more or less, we are profoundly ignorant. Nevertheless, we can here and there dimly catch a faint ray of light, and we may feel sure that there must be some cause for each deviation of structure, however slight."

Not so much even as a guess lies at the foundation of his theory.

No wonder that he says, respecting his theory (p. 199, *Origin of Species*):

"A crowd of difficulties will have occurred to the reader. Some of them are so serious that to this day I can hardly reflect on them without being staggered."

Page 300, Vol. ii.

"Throughout this chapter and elsewhere I have spoken of selection as the paramount power, yet its action absolutely depends on what we, in our ignorance, call spontaneous or accidental variability."

After speaking of those authors who attribute variation to what are manifestly but the *conditions* of variation, such as "an excess of food," "the amount of exercise taken," and "a more genial climate," he says:

"But we must, I think, take a broader view, and conclude that organic beings, when subjected during several generations to any change whatever in their conditions, tend to vary (*sic*); the kind of varying which ensues depends in a far higher degree on the nature or constitution of the being than on the nature of the changed conditions."

Page 302, Vol. ii.

"We will now consider, as far as we can, the causes

of the almost universal variability of our domestic productions. The subject is an obscure one; but it may be useful to probe our ignorance."

It is impossible for Darwin to take refuge behind any presumption, that the facts of variation are ultimate in their character, that they are inscrutable, and that therefore it is no reproach to him, or to his theory, that he has not generalized the facts; for, he precludes himself from the adoption of any such subterfuge by averring that "a cause for each variation must exist."

Thus, the base of Darwin's theory is ignorance!

It is true, that here and there, throughout his works, he seemingly endeavors to convey the impression, that the facts of variation are ultimate, and even forgets himself so far, in his work on *Animals and Plants Under Domestication*, as to assert that the problem of the cause of variations is "a difficulty as insoluble as is that of free will and predestination." (P. 516, Vol. ii, *Animals and Plants, &c.*)

It must be an occasion, for surprise, to the reader, that such an all important matter, as the cause or the law of the improvements, arising all around us, should receive the scant treatment of only a few sentences, scattered here and there, through Darwin's works. One would have thought that the great multitude of facts which he has collated, would have furnished, at least, a clue which the author might have wrought into some conjecture as to the law. He has several chapters on what he terms "The Causes of Variability," which might mislead his readers, if he did not, in the most explicit terms, state that these "causes" are not

causes at all, but merely the physical *conditions* of variability; and that they do not come under the category of laws or causes, in that higher sense in which the terms indicate a discovered method, under which natural forces are observed to work. He avers also that he would be "a bold man," who would esteem these physical conditions as of any account, in inducing variation, "in comparison with the nature or constitution of the being which varies."

The surprise, of the reader, however, at this neglect by Darwin of such an important inquiry, would doubtless much abate, were he to scan closely Darwin's facts, and have to confront him, a well known factor of development, which, upon Darwin's own showing, and own admission, fully explains every improvement which arises; but which, it was antecedently improbable, should find favor in the sight of Darwin, because that factor unequivocally negatives, and refutes Darwin's next, succeeding, and indispensable assumption, viz., that these improvements go on forever, or indefinitely. The discovery of this factor or law, might suggest to the reader, that Darwin, in being so complacently content with his ignorance of any cause for variation, was governed by the fear, that, if he evinced any great solicitude to find a cause, the cause might be only too ready in forthcoming, to the signal discomfiture both of himself and of his theory.

Darwin's "innate tendency," is postulated, and the ignorance, for which this "innate tendency" is confessedly the mere symbol, is assumed, in wanton derogation, and disregard, of a known, scientific law which

explains all the facts of variation, or of improvement, in animals and plants. The cause, or law, of variations and improvements, is not wrapped in such mystery as Darwin asserts it to be. The explanation of the improvements is to be found in his most prominent factor, Reversion; or the law of the regain of positive characters, or organs, once lost by ancient progenitors of the given species.

This law settles the question as to whether there is a limit to the improvements. This known scientific law explaining variations, imposes a definite limit to such variations, and thereby effectively disposes of Darwin's whole theory, which lays claim to being a probable hypothesis, only in the event of those improvements proceeding forever, or indefinitely. Not only is the origin of the improvements, as they occur, under domestication, and under nature, explained by this law of the regain of long lost characters of the respective species, but a full, qualitative, and quantitative analysis of the operation of those improvements after they have arisen is rendered possible; and the phenomena of crossing, of close interbreeding, of correlation, and of generation, in each and several of their many and diverse manifestations, are equally explicable, upon this assumption, viz., that the reason why individuals of any species improve, is because their ancient progenitors have under nature, in the struggle for existence, degenerated; and have lost, or had reduced, those features and organs which, now, when favorable conditions are supplied, reappear.

CHAPTER III.

THE VARIATIONS, OR IMPROVEMENTS, IN EACH SPECIES, LIMITED IN NUMBER AND KIND TO THE NUMBER AND KIND OF THE CHARACTERS PREVIOUSLY LOST BY SUCH SPECIES, UNDER NATURE: OR, THE LAW OF REVERSION.

There is no principle, or law, in the whole domain of Natural History, which Darwin so conclusively establishes, and which is attested by such a multitude of proofs, as what is known as the law of positive Reversion; or, the principle that each species, under nature, has suffered greatly from the effects of the Struggle for Existence, and has lost many characters, features or organs; and that when, as under domestication, the conditions of the individuals' environment are propitious, those lost characters, features, and organs reappear.

This law militates against the hypothesis of Darwinism, in two ways, First, a converse theory is deducible therefrom, which explains all of the phenomena, and so apportions the facts among Darwin's scientific factors, as to preclude the necessity of referring any of them to such confessedly objectionable entities as an "innate tendency," "a spontaneous variability," "a law of nature," "vital force," "nature and constitution of the being," etc. Second, this law conclusively negatives Darwin's gratuitous assumption, that varia-

tions, or improvements, may go on forever, or indefinitely; and shows that there exists a limit, within each species, to the amount of improvement of which its individuals are susceptible.

Darwin, in treating of this law of reversion, ascribes to it the appearance of nearly every improvement under domestication. Almost every character, and organ, which has been developed, under man's care, and those which have arisen induced only by the presence of favorable conditions of growth, he says, were once in some period past, in a perfect state, and fully developed in some remote ancestor; that, owing to adverse conditions, under nature, those characters and organs had become either wholly lost, or partially reduced; that those characters and organs lay latent, during the long interval, ready ever to be evolved again, whenever the favorable conditions, essential to their growth, were restored; and that their reappearance, under domestication, is due to this capacity of reversion, which resides in every individual whose structure has been impaired. Almost every feature, which has appeared under domestication, he, in detail, ascribes to the mere reappearance of some character, once lost by an ancient progenitor. So widespread, he asserts, has been the degeneration under nature, that there exists scarcely a single species which has not lost some organs or features. He asserts that characters which have been lost, may lie in the organisms, either in a rudimentary state, or with not a trace of them discernible; and do so lie, for thousands and millions of generations, with their power of reversion, or of re-development, undiminished; that, when

the individuals of any species, so deprived of some of its characters, are placed under domestication, or under other propitious surroundings, these characters not only may, but do reappear, and resume in a greater or lesser degree, the perfectly developed condition in which they were, originally. He actually shows, whilst affecting profound ignorance of the cause of variation, that the features and organs which were lost by each species under nature, are more than sufficient, in both number and kind, to account for all of the improvements which appear in such species under domestication, or which may appear under nature.

Any doubts, which may arise, in the reader's mind, as to whether Darwin has been truly represented in this connection, will assuredly be dissipated by the following copious and telling extracts, from Darwin's "*Origin of Species*," and from his "*Animals and Plants Under Domestication*."

With respect to past degeneration, or the loss of characters, and to present Reversion, or the regain of such lost characters, Darwin says (p. 126, *Origin of Species*):

"Characters reappear after having been lost for many generations."

"Organs in a rudimentary condition, plainly show that an early progenitor had the organ, in a fully developed state; and this, in some instances, implies an enormous amount of modification in the descendants" (p. 572, *Origin of Species*).

"With species, under a state of nature, rudimentary organs are so extremely common, that scarcely one species can be mentioned which is wholly free from a

blemish of this nature" (p. 381, Vol. ii, *Animals and Plants, &c.*).

Why should there be any mystery about the cause of variations, or improvements? In the second extract above, he asserts that these rudimentary organs plainly show, that an early progenitor had the organs in a fully developed state. In the last quotation, he says that, of species in a state of nature, there is scarcely one which has not these suppressed organs. Will not these assertions of his, cover and explain every favorable or positive variation which has arisen, or which may arise, under domestication, or under nature? When the animal or plant is placed under domestication, it improves solely by reason of the re-development of reduced, or suppressed organs. According to Darwin's own showing, each species is imperfect when taken from a state of nature; and, therefore, it is, that it possesses a certain margin for improvement. Within this margin, Man's care and selection are operative. No greater complexity of structure is ever acquired by an individual under domestication, than that which its species once lost. If any great variation, or change, has taken place under nature, this assertion of Darwin, viz., of the imperfection of each species, shows that such variation, or such change, has not, as he contends, been in the direction of increase of development; but, rather, in the direction of decrease, of degeneration, of devolution, instead of evolution. Indeed, the very conditions, under which he represents his Natural Selection as operating, imply degeneration, rather than any

advance in development. The loss of characters, under nature, explains the appearance of characters under domestication. The reduction of characters under nature, explains the improvement of characters under domestication. When the characters, lost under nature, are regained under domestication, Darwin absurdly argues that, because a certain number of characters have appeared within a certain time, he need only multiply such number of characters, by any given time, to ascertain the number which is possible to be acquired: Whereas, the fact is, the number of characters possible to be acquired, within any species, is not dependent upon any estimate of time, or of selection, but upon the number of the characters which have been lost by such species.

Continuing his remarks, respecting these rudimentary organs, he says:

"Such organs are generally variable, as several naturalists have observed; for being useless, they are not regulated by Natural Selection; and they are more or less liable to reversion. The same rule certainly holds good with parts which have become rudimentary under domestication. We do not know through what steps under nature, rudimentary organs have passed in being reduced to their present condition; but we so incessantly see, in species of the same group, the finest gradations between an organ, in a rudimentary and (in a) perfect state, that we are led to believe that the passage must have been extremely gradual. It may be doubted whether a change of structure, so abrupt as the sudden loss of an organ, would ever be of service to a species in a state of nature; for, the conditions to which all organisms are closely adapted, usually change

very slowly. Even if an organ did suddenly disappear in some one individual, by an arrest of development, intercrossing with other individuals of the same species, would cause it to reappear in a more or less perfect manner, so that its final reduction could only be effected by the slow process of continued disuse or natural selection. It is much more probable that, from changed habits of life, organs first become of less and less use, and ultimately superfluous; or their place may be supplied by some other organ; and then disuse, acting on the offspring through inheritance at corresponding periods of life, would go on reducing the organ; but as most organs could be of no use at an early embryonic period, they would not be affected by disuse; consequently, they would be preserved at this stage of growth, and would remain as rudiments."

Again on page 353, Vol. ii, *Animals and Plants*, &c., he says:

"With domesticated animals, the reduction of a part, from disuse, is never carried so far that a mere rudiment is left; but we have good reason to believe that this has often occurred under nature. * * * Structures which are rudimentary in the parent-species, become partially re-developed in their domesticated progeny. * * * They are of interest, as showing that rudiments are the relics of organs once perfectly developed."

"With Plants, the position of the flowers on the axis, and of the seed in the capsules, sometimes leads, through a freer flow of sap, to changes of structure; but these changes are often due to reversion."

"Domesticated races, descended from the same species, are liable to revert to characters derived from their common progenitor."

"Every one would wish to explain to himself, even

in an imperfect manner, how it is possible for a character possessed by some remote ancestor, to reappear in the offspring." (P. 428, Vol. ii, *Animals and Plants, &c.*)

"I have stated that the most probable hypothesis to account for the reappearance of very ancient characters, is, that there is a tendency in the young of each successive generation, to produce the long-lost characters; and that this tendency, from some unknown cause, sometimes prevails."

"It would be difficult to name one of the higher animals, in which some organ is not in a rudimentary condition." (P. 353, *Origin of Species.*)

By this, of course, he means "an organ which has been perfectly developed in some remote ancestor," and subequently suppressed. When, however, he is treating of variations which are due to the reappearance of these characters, under domestication, all recollection of what he here alleges, seems to forsake him; and he professes himself unable to account for them. He says, unqualifiedly, without distinction, that he is ignorant of the cause of the appearance of variations. As, in his search for the law of variations, he conveniently forgets these reduced and suppressed organs, and is so strangely obtuse to the fact, that they amply supply the cause for which he affects to seek, there exist, to his seeming, no objection to his settling down to the conviction, that variations are inexplicable; and no reason why he should not assume, that these variations or improvements go on multiplying, indefinitely, or forever. If, however, the variations are to be explained by the reappearance of long lost characters of the respective species, it is obvious that there must

be a limit to them. But, strangely enough, the deterioration of each species under nature, and the capacity of each species to regain what it has lost, slip Darwin's memory, in connection with the question of the cause of variations; and, therefore, there exists, for him, no assignable limit to the improvement of animals and plants. He treats of variations under domestication, as if they were clear gain to the species, to which the varying individuals belong, and proceeds to estimate thereupon a ratio of increase of development: Whereas, as he himself shows, variations are but the re-acquisition of what had been lost. Again: Is it not much more scientific, to ascribe variations to a known, scientific factor, such as is Reversion, than to ascribe them to an "innate tendency," or to "profound ignorance"?

Again he remarks (p. 51, Vol. ii, *Animals and Plants, &c.*):

"From what we see of the power and scope of reversion, both in pure races, and when varieties or species are crossed, we may infer that characters of almost every kind are capable of reappearing, after having been lost for a great length of time."

He might also have remarked: "From what we see of the power and scope of reversion, both in pure races, and when varieties are crossed, we may infer that characters of every kind," which appear under domestication, and positive variations of every kind, which may appear under nature, are not due to any "innate tendency;" but that they may be referred to this well-known scientific factor, Reversion.

On page 382, Vol. ii, *Animals and Plants, &c.*, he says:

"Organs which are naturally rudimentary, in the parent species, become partially re-developed in the domesticated descendants. Thus, cows, like most other ruminants, properly have four active, and two rudimentary mammæ; but, in our domesticated animals, the latter occasionally become considerably developed, and yield milk. * * * The hind feet of dogs include rudiments of a fifth toe, and in certain large breeds, these toes, though still rudimentary, become considerably developed and are furnished with claws. In the common hen, the spurs and comb are rudimentary, but in certain breeds, these become, independently of age, or disease of the ovaria, well developed. The stallion has canine teeth, but the mare has only traces of the alveoli, which, as I am informed by the eminent veterinary, Mr. G. T. Brown, frequently contain minute, irregular nodules of bone. These nodules, however, sometimes become developed into imperfect teeth, protruding through the gums, and coated with enamel; and, occasionally, they grow to a third, or even a fourth, of the length of the canines in the stallion. With Plants, I do not know whether the re-development of rudimentary organs, occurs more frequently under culture, than under nature."

On page 177, *Origin of Species*, he says:

"Rudimentary parts, it has been stated by some authors, and I believe with truth, are apt to be highly variable. * * * Rudimentary parts are left" (*i. e.* subject) "to the tendency to reversion."

On page 380, *Animals and Plants, &c.*, he says:

"With cultivated plants, it is far from rare to find the petals, stamens, and pistils represented by rudiments, like those observed in natural species. So it

is with the whole seed in many fruits; thus near Astrakhan there is a grape with mere traces of seeds, 'so small and lying so near the stalk that they are not perceived in eating the grape.' In certain varieties of the gourd, the tendrils, according to Naudin, are represented by the rudiments, or by various monstrous growths. In the broccoli and cauliflower, the greater number of the flowers are incapable of expansion, and include rudimentary organs. In the Feather hyacinth (Muscari *comosum*) the upper and central flowers are brightly colored, but rudimentary; under cultivation, the tendency to abortion, travels downwards and outwards, and all the flowers become rudimentary; but the abortive stamens and pistils are not so small in the lower, as in the upper flowers. In the *Viburnum opulus* on the other hand, the outer flowers naturally have their organs of fructification in a rudimentary state, and the corolla is of large size; under cultivation, the change spreads to the centre, and all the flowers become rudimentary; thus, the well-known Snow-ball bush is produced. * * * In these several cases we have a natural tendency (!) in certain parts, to become rudimentary, and this under culture spreads either to, or from, the axis of the plant."

Would it not be manifestly fallacious, if, when these rudimentary parts became re-developed (which Darwin asserts they are ever competent so to become) any one were to take such re-growth, and use it as the basis of a calculation of indefinite, or unlimited growth? If a person had cut his little finger, and then, observing the reparative power displayed, had estimated, from the degree of repair which had occurred, within a week, that, in a year's time, the finger would attain to the thickness of his thumb, he would not commit an ab-

surdity any greater than that, of which Darwin is guilty, when he takes variations which are but the mere regain of what the given species once lost, and concludes, from the amount of such improvements, that such species may develop into another species, higher in the scale of development.

Again, he says (p. 383, Vol. ii, *Animals and Plants, &c.*):

"Finally, though organs which must be classed as rudimentary, frequently occur in our domesticated animals and cultivated plants, these have generally been formed suddenly, through an arrest of development. They usually differ, in appearance, from the rudiments which so frequently characterize natural species. In the latter, rudimentary organs have been slowly formed through continued disuse, acting, by inheritance, at a corresponding age, aided by the principle of the economy of growth, all under the control of natural selection. With domesticated animals, on the other hand, the principle of economy is far from coming into action, and their organs, although often slightly reduced by disuse, are not thus almost obliterated, with mere rudiments left."

Under the heading, "Rudimentary, Atrophied, and Aborted Organs," he says (p. 533, *Origin of Species*):

"Organs, or parts, in this strange condition, bearing the stamp of inutility, are extremely common, throughout nature. * * I presume that the 'bastard wing,' in birds, may be safely considered as a digit in a rudimentary state; in very many snakes, there are rudiments of the pelvis and hind limbs. Some of the cases of rudimentary organs are very curious; for instance, the presence of teeth in fœtal whales which, when grown up, have not a tooth in

their heads; and the presence of teeth, which never cut through the gums, in the upper jaws of our unborn calves. It has even been stated, on good authority, that rudiments of teeth can be detected in the beaks of certain embryonic birds. Nothing can be plainer than that wings are formed for flight; yet in how many insects do we see wings so reduced in size as to be utterly incapable of flight, and not rarely lying under wing-cases, firmly soldered together! The meaning of rudimentary organs is often quite unmistakable; for instance, there are beetles of the same genus (and even of the same species) resembling each other most closely in all respects, one of which will have full-sized wings, and another mere rudiments of membrane; and here it is impossible to doubt that the rudiments represent wings. * * * In plants of the same species, the petals sometimes occur as mere rudiments, and sometimes, in a well-developed state. In some plants with their sexes separated, the male flowers include a rudiment of a pistil."

When these animals and plants are placed under domestication, or cultivated, the rudimentary organs which "relate to a former condition," become re-developed; and then Darwin proceeds to calculate, thus for instance: If this beetle (say) has developed a pair of wings, within one year, is it not probable that, at the same rate of variation, it may develop into an eagle, in the course of the next million years?

"Rudimentary organs may be utterly aborted," * * with "no trace left" (p. 533, *Origin of Species*).

Darwin adduces variations, or improvements, under domestication, to prove how transitions from lower to higher specific forms may be made, and have been made; but, in the very exposition of his problem, he

shows that, in the past, there have been, in each species, many transitions from a previously higher form to the lower, degenerate form now extant, under nature; and, that the improvements, which he adduces to prove the transition of a species to higher forms, are but the steps which the organism takes to retrieve its lost ground, to regain its lost characters, to recover its lost integrity.

In the consideration of the problem, the reader must bear in mind, that, even according to Darwin's own showing, any advance, or improvement, under nature, is at the best problematical: Darwin urges only, that it is not improbable that a variation such as those which occur under domestication, should occur under nature, "once in a thousand generations;" whereas, on the other hand, degeneration, in the past, under nature, is well attested, unquestionable, and wide-spread, covering every species of animal and plant. So far from there having been such advance, in development, as is competent to the evolution of the different species, there have not been, upon Darwin's own showing, sufficient improvements or variations, to retrieve a tithe of the deterioration which many species are positively known to have suffered!

The above remarks, and quotations, refer principally to lost characters which have left some traces of their past existence. There are, however, many more characters or organs, belonging to the different species, which have been so entirely suppressed, that not a vestige of them is discernible, before they commence to reappear. The prototype of each species, was an

organism of a higher state of development than the type of such species, as now found under nature. Adverse conditions entailed the suppression of the characters; and the mere restoration of the favorable conditions, secures their re-development.

The races of each species, under nature, were formed, exclusively, by the varied modification of the one, original, perfect mould of such species. These races are, all, but various degenerations of the one specific type of the given species. By this, it is not meant to imply any "innate tendency" (such as Darwin postulates) in organisms, to degenerate. Certain conditions were needed for the full and proportionate development of the characters of each species. The withdrawal of some of those conditions, entailed the reduction and suppression of some of the characters—of those characters to which those conditions were immediately correlated. While the conditions remained favorable, the species held its own; when the conditions changed —when the state of affairs ensued, which Darwin represents in his Struggle for Existence—loss of characters, and loss of size resulted. As these adverse conditions varied in degree, and in kind, in different districts and countries, the degree and the manner in which the individuals became modified, were also different. The structure of each race, became slightly different from that of the other races of the same species; because the conditions, in one country, wrought a deleterious effect on one organ or character, and the conditions, in the other countries, wrought injury upon other parts of the organization.

Starting out, therefore, with these degenerate individuals of a species, Darwin essays to prove that their development may proceed *ad infinitum*—and the evidence, he adduces to countenance such an hypothesis, is that, when placed under favorable conditions, those individuals regain the characters which they once lost! The true, and only, induction from his facts, is, that there are no positive characters which appear, which are not due to the principle of reversion. The reader should bear in mind, that the problem is, not how species with all their characters, have been evolved; but, how have been evolved those slight increments of development, which constitute the data of all the prevailing theories of Evolution—those positive variations, or improvements, which arise under domestication, and (perhaps) under nature. The problem, How species have been evolved, is the point to which Darwin addresses himself. But, in the solution of that problem, he has availed himself of these variations, and he professes, that these variations solve the question. If, however, these variations be due to reversion —if they be but the regain of what was once lost— (which he furnishes such ample warrant for believing) then is he mistaken in his belief, that they explain the evolution of species. Therefore it is, that the problem of the evolution of species, gives place, in this controversy, to the problem of the cause of variations; and, to the question whether there be a limit to the improvements of which any species is shown to be capable. If each species is capable of that amount, only, of growth or development, of which it was pos-

sessed, at some time in the past; then, there is an end to Darwin's hypothesis, which is tenable, only upon the supposition, that the progress displayed by such species is new growth (*i. e.*, new to the given species) or new development; and upon the supposition that there is no limit to such progress, or variation.

Respecting the degeneration, which has taken place in the past under nature, and the capacity, ever resident in the deteriorated individuals, to recover what they lost, Darwin says (p. 188, *Origin of Species*):

"No doubt it is a very surprising fact, that characters should reappear, after having been lost for many, perhaps, for hundreds, of generations. * * * In a breed which has not been crossed, but in which both parents have lost some characters which their progenitor possessed, the tendency, whether strong or weak, to reproduce the lost characters, might be, as was formerly remarked, for all that we can see to the contrary, transmitted for almost any number of generations. When a character, which has been lost in a breed, reappears, after a great number of generations, the most probable hypothesis is, not that the offspring suddenly takes after an ancestor some hundreds of generations distant, but that, in each successive generation, there has been a tendency to reproduce the character in question, which, at last, under unknown favorable conditions, gains an ascendancy."

This power of reversion, as he says, is ever operative, and is only kept down by adverse conditions. Each individual of a species would, were the conditions propitious, develop all the positive characters, known to any individual of its species.

Continuing, he says:

"I can see no more abstract improbability in a tendency to produce any character, being inherited for an endless (!) number of generations, than in quite useless and rudimentary organs, being as we all know them to be, thus inherited. Indeed, we may sometimes observe that a mere tendency to produce a rudiment, is inherited."

Again, on p. 27, *Origin of Species*, he says:

"When there has been no cross with a distinct breed, and there is a tendency in both parents to revert to a character which has been lost, during some former generation, this tendency, for all that we can see to the contrary, may be transmitted, undiminished, for an indefinite number of generations."

On page 446, Vol. ii, *Animals and Plants, &c.*, he says:

"What can be more wonderful, than that characters which have disappeared during scores, or hundreds, or even thousands (!) of generations, should suddenly reappear, perfectly developed, as in the case of pigeons and fowls."

The characters lost, do not, in any wise, lie within the organisms, during the interval before their reappearance. The forces of the organization are, when all the characters are fully and proportionately developed, beautifully correlated together, making one, determinate coördination. When a character is lost, the forces so correlated, are capable of reintegrating the lost part, and of restoring the mutual relations of the parts; if the conditions will allow. Cut off the edge of a crystal; the crystal may remain, so impaired,

for a hundred or a thousand years, and when placed in a solution, like that in which it was originally formed, it will restore the lost edge. No one will say, that the lost edge remained in embryo, or in any way, within the crystal, during that period. It was the correlation of the forces of the crystal, which conspired to effect the reintegration which was so necessary to the normal coördination of the whole. So is it with organic reversion. The capacity for reintegrating is, generally to the full as efficient, after a thousand generations, as it would be after the lapse of a day, or of an hour. All of the improvements, effected by breeders, fanciers, horticulturists, and agriculturists, are but reintegrations, partial or complete, of the animals and plants.

"This principle of Reversion is the most wonderful of all the attributes of Inheritance. * * * Reversion is not a rare event, depending on some unusual or favorable combination of circumstances, but occurs so regularly, with crossed animals and plants, and so frequently, with uncrossed breeds, that it is evidently an essential part of the principle of inheritance. We know that changed conditions have the power of evoking long-lost characters, as in the case of some feral animals. The act of crossing in itself possesses this power in a high degree."

The reason, that "changed conditions have the power of evoking long-lost characters," is because, upon a change, those conditions are restored to the individual, the absence of which entailed the loss of those characters. Crossing "possesses the power in a high degree," because the union, in the offspring, of the two peculiarities, derived respectively from the two

parent breeds, so strengthens the correlation of the forces of the organism, as to enable it, the more, to repair its lost integrity.

Continuing, he says:

"Many monstrosities come under this same head, as when rudimentary organs are re-developed, or when an organ which we must believe was possessed by an early progenitor, but of which not even a rudiment was left, suddenly reappears, as with the fifth stamen in some Scrophulariacæ. We have already seen that reversion acts in bud-reproduction; and we know that it occasionally acts during the growth of the same individual animal, especially, but not exclusively, when of crossed parentage—as in the rare cases described of individual fowls, pigeons, cattle and rabbits."

"We are led to believe, as formerly explained, that every character which occasionally reappears, is present in a latent form in each generation. * * * In every (!) living creature, we may feel assured that a host of lost characters lie ready to be evolved under proper conditions. How can we make intelligible, and connect with other facts, this wonderful and common capacity of Reversion—this power of calling back to life long-lost characters!"

"Long-lost characters," break out in mystic refrain, upon almost every page of his works. Why he does not see, that these "long-lost characters" are attuned most harmoniously to the improvements which arise, is a psychological phenomenon which it behooves us not here to explain. Yet, we cannot help suspecting, and cannot refrain from delicately intimating, that either a dim, or a well-defined consciousness, on his part, that the discovery of the harmony of these "long-

lost characters," with the variations which he, in his ignorance, attributes to spontaneous variability, would sound the knell of Darwinism; alone prevented him from disclosing the part these "long-lost characters" play, in the grand diapason of Biology. In a future chapter, it will be shown, that each organism is as a sweet bell, jangled and out of tune, if these "long-lost characters" fail to join in that symphony of correlation which, when perfect, alone may make the coördination which is consistent with physiological integrity.

On page 14, Vol. i, *Animals and Plants, &c.*, he says:

"By thus adding up variations, he (man) has effected wonderful changes and improvements."

This sum of variations, or improvements, avails his argument just nothing; for, he shows, that the only scientific view is, that this sum of improvements effected, is but the sum, or part of the sum, of characters once lost by the varying species. To show that a species has been divested, by unfavorable conditions, of a number of characters; and then, when the individuals of that species regain those characters, to proceed to estimate a ratio of indefinitely continued development, is obviously absurd.

On page 54, Vol. ii, *Animals and Plants, &c.*, he says, under the heading, "Crossing as a Direct Cause of Reversion":

"It has long been notorious, that hybrids and mongrels often revert to both or to one of their parent forms, after an interval of from two to seven or eight generations, or, according to some authorities, even a

greater number of generations. But, that the act of crossing, in itself, gives an impulse towards Reversion, as shown by the reappearance of long-lost (!) characters, has never, I believe, been hitherto proved. The proof lies in certain peculiarities which do not characterize the immediate parents, and therefore cannot have been derived from them, frequently appearing in the offspring of two breeds when crossed, which peculiarities never appear, or appear with extreme rarity, in these same breeds, as long as they are precluded from crossing."

This remark, of his, attests strongly, that he has settled in his own mind, that all the improvements which arise, are due to Reversion. He says, "The proof lies in" the appearance of "certain peculiarities which do not characterize the immediate parents and therefore cannot have been derived from them." It will be observed, that this circumstance, viz., of the characters not having been derived from the immediate parents, he makes the sole criterion of their being due to Reversion. The rest of his sentence, has relation to his proof, that crossing gives an impulse to this Reversion. That is the true law, namely that positive characters, which are not derived from the immediate parents, are due to Reversion. Had he, however, formulated this rule in set terms, it would have provoked an immediate response to his gratuitous assumption, that there is no limit to variations. This, his assumption, of no limit to improvements, is the witching point in the whole controversy. Yet, strange to say, such assumption is not formulated even once, but remains a tacit assumption merely, throughout all

his works! To all seeming, he thought it discreet to advance that point in his theory, by implication solely. If he had explicitly stated, that all the characters which arise in each individual, and which did not characterize that individual's immediate parents, are long-lost characters reappearing by Reversion, the fallacy of his theory would immediately have become glaring. For, if each and every variation, or improvement, is but the regain of what was once lost, it is, then, an unavoidable corollary, that variation has a limit, which will be reached in each individual, when all of its lost characters are regained. All of the improvements, which were assumed to be increments of evolution, obeying those mysterious laws, "innate tendency," and "spontaneous variability," are then, manifestly, to be relegated to that known, well-established, scientific factor, Reversion.

Continuing his remarks, respecting the reappearance of long-lost characters, which is occasioned by Crossing, he says, "As this conclusion seems to me highly curious and novel, I will give the evidence in detail." He then gives numerous instances with the pigeon, with the fowl, with the duck, with the rabbit, with the cow, with the horse, and with the ass; and says:

"It would appear, that, with crossed animals, a similar tendency to the recovery of lost characters, holds good with instincts;"

And gives instances, in the case of the fowl, of cattle, of the pig, of the duck, of the horse, and of the ass. Everything is "highly curious," with him, as it must be, with every scientist, who essays to colligate

facts, with a theory based upon an assumption which is not only wholly gratuitous, but in wanton derogation of a competent, known, and well-established, scientific factor. The phenomenon of the recovery of long-lost characters, by means of crossing, is shown, in a future chapter of this work, to be perfectly explicable.

"In many cases," says he (p. 105, Vol. ii, *Animals and Plants, &c.*), "the failure of the parents to transmit their likeness, is due to the breed having been at some former period crossed; and the child takes after his grandparent, or more remote ancestor, of foreign blood. In other cases, in which the breed has not been crossed, but some ancient character has been lost through variation, it occasionally reappears through Reversion, so that the parents apparently fail to transmit their own likeness. In all cases, however, we may safely conclude that the child inherits all its characters from its parents, in whom certain characters are latent. * * * When, after a long succession of bud generations, a flower or fruit becomes separated into distinct segments, having the colors or other attributes of both parent forms, we cannot doubt that these characters were latent in the earlier buds, though they could not then be detected, or could be detected only in an intimately commingled state. So it is with animals of crossed parentage, which, with advancing years, occasionally exhibit characters, derived from one of their two parents, of which not a trace could at first be perceived."

Again he says, on the same page with the above remarks:

"It is assuredly an astonishing fact, that the male and female sexual elements, that buds, and even full-grown animals, should retain characters, during several

generations, in the case of crossed breeds, and during thousands of generations, in the case of pure breeds, written as it were in invisible ink, yet ready, at any time, to be evolved under the requisite conditions."

"What these conditions are, we do not in many cases at all know. But, the act of crossing, in itself, apparently from causing some disturbance in the organization, certainly gives a strong tendency to the reappearance of long-lost characters, both corporeal and mental, independently of those derived from the cross."

The purpose in quoting this, and other remarks of Darwin, upon the subject of long-lost characters, is, to show the wide-spread operation of Reversion, and its competency to cover all the variations adduced by Darwin. Having thus furnished full warrant for the assumption of Reversion as the sole cause of all positive variations, or improvements, we shall also enlighten him as to what those mysterious conditions are, of which he speaks, and as to what that curious "some disturbance in the organization," is.

On page 113, Vol. ii, *Animals and Plants, &c.*, he says:

"But in all cases" (of crossing different breeds) "there will be, during many subsequent generations, more or less liability to reversion. * * * In considering the final result of the commingling of two or more breeds, we must not forget that the act of crossing in itself tends to bring back long-lost characters, not proper to the immediate parent-forms."

Again, on page 212, Vol. ii, *Animals and Plants, &c.*, he speaks of

"The excessive variability of the crossed offspring due to the principle of reversion."

On page 319, Vol. ii, *Animals and Plants, &c.*, it is amusing to remark, with what an air of judicial impartiality, he insinuates, that there are characters independent of reversion.

* * * "It is probable," says he, "that the crossing of two forms, when one or both have long been domesticated or cultivated, adds to the variability of the offspring, independently of the commingling of the characters derived from the two parent forms, and this implies that new characters actually arise."

The implication is, merely, that they are new to either of the crossed *breeds;* and upon this construction, Darwin is right. It is evident, too, that this is the idea he had in his mind. But, the idea he evidently desires to convey, under the shadow of the double meaning of which his words are susceptible, is that they are new to the given *species;* an idea, which he is ever intent upon insinuating, and an idea which is absolutely essential to the support of his theory. Mark the tone of the following sentence—a tone which is ingeniously calculated to convey to the readers' minds, the conviction that they may place implicit confidence in him, and count most securely upon his duly qualifying his remarks, and upon his not overstating the strength of the evidence he adduces.

Continuing:

"But we must not forget the facts advanced in the thirteenth chapter, which clearly prove that the act of crossing often leads to the reappearance or reversion of long-lost characters; and in most cases, it would be impossible to distinguish between the reappearance

of ancient characters, and the first appearance of new characters."

This, again, may mean characters new to either of the crossed *breeds*, or characters new to the *species*. It is, obviously, to the interest of Darwin's theory, that the latter idea be accepted by the reader. If it be so "impossible to distinguish between the reappearance of ancient characters, and the first appearance of new characters," why, in any case, refer them to an "innate tendency," or to "profound ignorance," in derogation of the known, scientific law, Reversion, to which no possible objection can be taken? Assume, as there is so much ground for doing, that all the variations, arising in each species, are but the regain of what that species once lost, and "innate tendency," "vital force," "spontaneous variability," and all the other "metaphysical entities," which clog the path of inquiry, and attest the poverty of scientific thought, may be wholly dispensed with.

Continuing his remarks with reference to the question whether the given characters are "ancient" or "new," he says:

"Practically, whether new or old, they would be new to the breed in which they reappeared."

Doubtless, they would; as a breed formed of the varying offspring of a cross, is, generally, a new breed.

Again he says (page 321, Vol. ii, *Animals and Plants, &c.*):

"We seldom have the means of distinguishing, as previously remarked, between the appearance of really

new characters, and the reappearance of long-lost characters evoked through the act of crossing."

Darwin in Chap. xxivth, of his *Animals and Plants, &c.*, reviews all of the *conditions* of development, viz., food, exercise, climate, crossing, &c., which divers authors have ignorantly regarded as the *causes* of variability; and he says (p. 303, Vol. ii):

"But we must, I think, take a broader view, and conclude that organic beings, when subjected during several generations to any change whatever in their conditions, tend (!) to vary; the kind of variation, which ensues, depending in a far higher degree on the nature or constitution (!) of the being, than on the nature of the changed conditions."

On the preceding page, he says:

"The subject (*i. e.*, of "the causes of the almost universal variability of our domesticated productions") "is an obscure one; but it may be useful to probe our ignorance."

With him, the obscurity arises from this: That he finds it "impossible" to distinguish between the reappearance of ancient characters, and the first appearance of "new characters," because, the characters which arise are *all* "ancient characters."

He says that variation may be accounted for,

"By the more or less complete recovery, through reversion, of ancestral characters on either side; but we thus only push the difficulty further back in time, for what made the parents, or their progenitors different?"

If the explanation by means of Reversion, only pushes the difficulty further back in time, why does

he, then, adduce variations as the data for his theory? He essayed to solve the problem of indefinitely continued development, by means of variations. Variations are then shown to be incapable of sustaining his theory; because, being but the regain of what was once lost, they have a limit; and proof of a limit to the improvements, constitutes complete disproof of his theory. But, with a coolness most unique, he rejoins, To explain the variations by means of Reversion is only pushing the difficulty further back; for, they need to be explained, when they appeared for the first time, and effected the development of the different species; Whereas, this assumption, of his, viz., that the characters did arise originally, as variations, and did thereby effect the development of the different species, is the very point in controversy, and which he started out to prove.

What puzzles him, and so "obscures" the subject of the cause of variations, is, that he feels logic prodding him to know, Why, if reversion is "only pushing the difficulty further back in time," he does not meet the issue at that point further back in time, and there grapple with his problem; and, What business, or concern, has he with the improvements or variations under domestication, or with those variations, under nature, which occur at a period subsequent to the great degeneration he has shown, when, by his own confession, the issue does not hinge where he essays to meet it, but rests at a point, in the past, respecting which, not a syllable of evidence, or even a word of mention, is adduced by him throughout all of his works.

A fair analogue of Darwin's argument, is this: An individual lays claim to a piece of real estate, of which another has long been, and is, in adverse possession. The evidence adduced by the plaintiff to sustain such claim is—the plaintiff's satisfaction of what purported to be a mortgage upon the property, given by the plaintiff; and to the objection, naturally raised, that such evidence is no proof of any acquirement of title, by the plaintiff, to the property, the insensate retort comes, That is "merely pushing the difficulty further back in time." True, true "as proof of Holy Writ;" but make your testimony competent and relevant, by adducing evidence which has some relation to that difficulty further back in time:—would obviously be the response of the defendant.

So, to Darwin it may be said: If Reversion accounts for the improvements under domestication, and for those which are assumed occasionally to appear under nature, and such explanation but pushes the difficulty further back in time, why not adduce, instead, evidence and arguments which meet that difficulty further back in time?

A true conception of the relation in which Darwin's theory of evolution, stands to the law of Reversion, may be gained, if the reader does but fancy Darwin standing by a canal-lock, immediately subsequent to the passage of a boat, from the river above, to the channel below. He turns to the lock-master, and assures him, that he can explain to him clearly, how the river was originally formed:—If you will notice the action of the water within this lock, you will ob-

serve, that the water is rising slowly, by a succession of apparently spontaneous impulses. Since I have been standing here, the water has arisen some four or five feet. Now, it is clear, that this water may arise to any height, if it be confined above, by a wall, as it is below. It is manifestly gratuitous, for any one to assume a limit to the ascension of this water. It has been ascending, during the whole time I have been standing here, and the presumption is, in default of proof to the contrary, that it ever will continue so to rise. Now, the formation of the whole river, may be clearly demonstrated by analogy with this lock. It is fair to assume that, in the river, also, there exist, and have ever existed, spontaneous impulses of water, similar to what we here observe. Given, then, those ascending, spontaneous impulses, the formation, in the past, of this river, becomes clear.

To the response of the lock-master, that Darwin evidently does not understand the reason, or the cause, why the water so ascends in the lock, he rejoins, that there is the fact—that suffices for him—and that an inquiry into efficient causes is metaphysical. The lock-master explains, that the water has previously fallen below the level of the river above, that it is now returning to that level, and that his theory of the unlimited ascent of the water, is all wrong, for the limit will be reached when the water reaches the plane of the river above.

Darwin recognizes the truth of such explanation, but declares that that is but pushing the difficulty farther back in time; for, how account for these origi-

nal, spontaneous impulses, when they first arose, and formed the river!

The lock-master declares, that these spontaneous impulses never did form the river, but that Darwin himself started to prove that very point; and now, instead of proving it, he assumes it to obviate a fatal objection to that very idea. He also shows him that he cannot prove the origin of the river by means of the spontaneous impulses in the lock, for they are due to the action of a river already formed. Darwin, however, is proof against all objections, and departs to assure his friend Tyndall that his theory, about "giving the religious sentiments of mankind, reasonable satisfaction," is altogether Utopian.

So, in his theory of development, he assumes his very conclusion—viz., that variations formed the different species—to ward off the objection, namely, that variations did not constitute the process of development, because they are but the regain of developments lost.

As all of the individuals of a species have, generally, lost the same characters, and all have the same capacity for regaining such characters, it is to be expected, that the individuals of the several varieties of such species, will not confine themselves to the development of the peculiarities which man has assigned them, but will display their power of reversion in characters, of their species, other than those which mark their respective varieties. The fact, also, that similar varieties are produced in different countries, from individuals of the same species, attests strongly, that the

improvements or variations which arise, are due to reversion. Darwin has noted this disposition, on the part of individuals of a species, to develop all of the characters of the given species, and refers it, as he should, to the fact of these characters having once been lost, and to the capacity, in each of the individuals, to regain such characters. As if fearful, that the significance of the phenomenon, should thrust itself upon the reader's attention, to the prejudice of his hypothesis of development without a limit, he assures his readers, that he is "concerned not as hitherto with the *causes* of variation, but with the *results*." He concerns himself about the causes of variation, only when he is engaged upon an enumeration of the conditions of variation (such as food, and climate, and exercise, &c.) which he is able to demonstrate, can furnish no adequate explanation of the appearance of the improvements. When, however, he trenches upon a well-known, scientific law, such as is reversion, he hastens to add, that all discussion upon causes, has been closed!

On page 417, Vol. ii, *Animals and Plants, &c.*, under the heading, "Analogous or Parallel Variation," he says:

"By this term I wish to express that similar characters occasionally make their appearance in the several varieties or races descended from the same species. * * * We are here concerned, not as hitherto with the causes of variation, but with the results; but this discussion could not have been more conveniently introduced elsewhere."

All of the individuals, of a species, are lacking in

characters which their ancient progenitors had; and, of course, each does not tamely submit to the development alone of that character to which the conditions at first gave the ascendant, and which man afterwards made very predominant, but strives ever to regain all of the characters which it lacks, or (as Darwin once happily puts it, when he approaches very near to the true law of development) "to bring all of the parts again into harmony with each other."

Darwin proceeds to arrange the "*results*" into classes:

"The cases of analogous variation, so far as their origin is concerned, may be grouped, disregarding minor sub-divisions, under two main heads; firstly, those due to unknown (*sic*) causes having acted on organic beings with nearly the same constitution, and which consequently vary in an analogous manner; and secondly, those due to the reappearance of characters which were possessed by a more or less remote progenitor."

When a scientist has a body of facts, and has, empirically, or provisionally, arranged them under two heads; one head consisting of facts presumably due to "unknown causes," and the other head comprehending facts acknowledging a known, scientific factor; he, when he is a fair, as well as able scientist, tests all of those facts, and when he finds that the known cause will cover all of the phenomena under either head, and that no possible exception may be taken to the competency of such factor, so to cover all, he relegates them all to one head—to the one known cause; and

dispenses with the services of the "unknown cause." This is the *modus operandi* of an able scientist who has not a pet theory, to which a recognition of the competency of the known cause, to cover all of the facts, threatens instant explosion. This, however, is not the mode of research of a scientist, who has a theory of the character mentioned. This is not, as is manifest, the mode of Darwin. All of the phenomena of variation, are, as he concedes, with an unimportant qualification, possible to be ranged under his second head, viz., Reversion; and there is not a single fact, to be found in any of his works, or within the range of physiology, which militates against such a course. But, should he so arrange them, and dispense with his "unknown causes," with his "innate tendency," etc., in which he fancies he has at least a ghost of a chance of salvation for his theory; where would be even his flimsy semblance of support for the hypothesis of indefinitely continued development?—of variation without any assignable limit? One, disposed to suspicion, and to invidious comment, might doubtless assert, that Darwin saw there was no earthly necessity for his class of "unknown causes," and that, to preclude the immediate dissolution of his theory, into the thinnest of air, with "infinite dexterity of wit," threw in the following remark, to occasion a bewildering doubt, in his readers' minds, as to whether the problem of the cause of variation, was so simple as it really is. He says, immediately subsequent to his elaboration of the two heads mentioned,

"But these two main divisions can often be only

conjecturally separated, and graduate, as we shall presently see, into each other."

Now, the only warrant he has for this assertion is, that some changes in an organism, and some varietal types are not due to Reversion. They are not due to Reversion, merely because they are negative changes, negative variations, or types which are formed by modifications of the original perfect type of the species to which they respectively belong. A cat or dog loses its ear: A pig is modified by the reduction, or the suppression of its tusks, its bristles, its tail, its legs, and its snout: These are the kinds of changes to which he appeals, to show that his unknown causes are operative. He fancies, or affects to believe, that the Fantail pigeon, for instance, cannot be due to Reversion, because the species from which it is known to have descended, has produced varieties with a well developed œsophagus, with length of body, with a long beak, with divergent feathers on the neck and breast, &c. But, it is not the *type* which has been regained by Reversion, but those positive characters, or features of development, which enter into such types. *The feature*, fan-tail, is due to reversion. All the positive features of the other varieties of the pigeon, are due to reversion; the *types* of those varieties are not. There was but one type originally; that type in which is contained all the positive developments of the given species; and that type alone is perfect.

Sometimes, it is true, there is a reversion, by an organism, from a positive character, to a negative character. Thus a pig, once under cultivation, has

been suffered to run wild; or little care has been taken of it. Its offspring are placed under cultivation, and they return to the condition in which their progenitor was; they have their legs, tusks, bristles, snout, &c., reduced. This is negative reversion, however. This is the dexterous way in which Darwin clouds the subject of the cause of the positive variations, which, as he essays to prove, were successively accumulated, and made to produce all positive developments. . This is the manner in which he redeems his promise of showing that his "two main divisions" of "unknown causes," and of a known cause, graduate into each other.

All of the *positive* variations; all the *positive* changes; all the *positive* improvements; all the *positive* increments of growth or of development; all the advances made by organisms from comparative simplicity to complexity of structure, which Darwin fain would accumulate, *ad infinitum;* are due to Reversion. If the conditions of the growth of a character, are taken away, the character becomes reduced, or suppressed. If Darwin desires to exalt adverse conditions, to the dignity of "unknown causes," and show that species may change one into another, by removes from complexity to simplicity of structure, he stultifies his theory of evolution, which predicates advance in development; but, we are prepared to meet even that issue, and do so meet it; for we show, in the chapters following, treating of crossing and of close interbreeding, that no individual is capable of any remove from complexity to simplicity of structure, and that no

character of any species is possible to be reduced in any way, or suppressed, without impairing the constitutional vigor and fertility of the organism; and that such reduction or suppression of the characters of a species, may progress to a very slight extent only, without entailing complete sterility, and a general breaking up of the whole constitution,—very soon ending in death.

But, Darwin started to prove the evolution of species from one another, by means of slight, successive advances in development, or variations. This issue we meet, by conclusively showing, that the variations to which he appeals, could not have produced the development in question, because they are amenable to a limit, very soon reached; and, because every such increment, or every such variation, which is of a positive character, is but the mere regain of a character lost, by the species in which it occurs, by a process of degeneration conclusively established by Darwin himself. But, one-half of the time, Darwin seems to have forgotten his predicate, and postulates, in the stead thereof, degeneration. He, instead of showing the evolution of species, seems rather to contend, that all the different species have been produced by degeneration,—that they are all various degenerations of some higher type. Notably, in his work on the "*Fertilization of Orchids*," which is a work ancillary to his "*Origin of Species*," does he argue that the different species are modifications of one higher type. But, even the hypothesis of degeneration, is refuted by the converse theory, propounded in this work. As

above mentioned, it is proven that an animal is not capable of modification in any of its characters, without proportional injury to its physiological integrity; and that a distinct species may not be produced by such a process of degeneration; for, sterility and death ensue, before half of the requisite amount of change, in structure, can be effected.

Speaking of the "similar characters," which "make their appearance in the several varieties or races descended from the same species," he says:

"These facts are important from showing, as remarked in a former chapter, that each trifling variation is governed by law, and is determined, in a much higher degree, by the nature of the organization, than by the nature of the conditions to which the varying being has been exposed."

Darwin confesses, that, of this "law," and of "the nature of the organization," he is wholly ignorant. As he says, "Our knowledge of the cause of variation is profound." For "law," and for "the nature of the organization," read, the power of reversion of characters once lost by the given species; and the above counters for ignorance may be eliminated from the problem.

Again he says (page 502, Vol. ii, *Animals and Plants, &c.*):

"Although every variation is either directly or indirectly caused by some change in the surrounding conditions, we must never forget that the nature of the organization which is acted on, essentially governs the result. Distinct organisms, when placed under similar

conditions, vary in different manners, whilst closely allied organisms under dissimilar conditions, often vary in nearly the same manner. We see this in the same modification frequently reappearing at long intervals of time in the same variety, and likewise in the several striking cases given of analogous or parallel varieties. Although some of these latter cases are simply due to reversion, others cannot thus be accounted for."

The only reason he can advance, for urging that some positive variations "cannot thus be accounted for," is, that he does not know of any individuals of the species under nature, in which the characters which arise, are to be seen. It is clear that, if degeneration has been so rife under nature, then, this objection cannot obtain.

On page 307 (Vol. ii, *Animals and Plants, &c.*), he says:

"Bud-variation, which we fully discussed in a former chapter, shows us that variability may be quite independent of seminal reproduction, and likewise a reversion to long-lost ancestral characters."

In this former chapter, to which he alludes, he says (p. 449, Vol. i, *Animals and Plants, &c.*):

"Nor can we account, in all cases, for the appearance, through bud-variation, of new characters, by the principle of reversion to long-lost characters."

Darwin's inability to account, by reversion, for some of the variations, is due to his idea that varietal *types* could thus to be explained. It is not the *types*, which can be explained by reversion; but those positive

features which arise. That it is this idea (viz., that varietal types negative the hypothesis of reversion, because such types were never known in the past), which causes him to urge, that there are variations, not due to reversion, is shown in the following remarks of his (p. 488, Vol. i, *Animals and Plants, &c.*):

"Many cases of bud-variation, however, cannot be attributed to reversion, but to spontaneous variability (*sic*), such as so commonly occurs with cultivated plants, when raised from seed. As a single variety of the Chrysanthemum has produced by buds six other varieties, and as one variety of the gooseberry has borne, at the same time, four distinct varieties of fruit, it is scarcely possible to believe that all these variations are reversions to former parents."

The six varietal *types* of the Chrysanthemum, are not due to reversion. Nor are the types of the four varieties of the gooseberry. But the *positive features* which have arisen in the six varieties of the Chrysanthemum, are due to partial reversions to that original perfect type of the Chrysanthemum, which was the sum of all the positive characters of the species. By modifying this original type of the species, it might be possible to obtain a hundred varietal types. What complicates the problem somewhat, is, that these varieties are not the result of direct modifications of the original form. But, that original form has been reduced to the degenerated condition in which the plant is, under nature. Then, it is placed under cultivation; and, because it regains, in different ways, the characters it lost, different varieties or types are formed; and

when the idea of reversion is suggested, in connectio with any variety, the possibility of the type of suc variety, having previously existed, is entertained b the mind, and rejected under a false conception o the solution. So, also, the idea, of there having ex isted in the past, as many types as there are varieties o the given species, is rejected, and the hypothesis of re version accordingly suffers. The fact is, that, for eac species, there originally existed a type (then realize in the members of such species), which included within it, all of the characters which it was ever pos sible for any member of that species to develop. Thi type, it is possible to modify in an infinity of ways but, as is shown in future chapters of this work, eac such modified type, suffers physiological evil in pro portion to the amount of modification it displays.

From the above quotation, it is made manifest t the reader that, if Reversion cannot account for varia tion, the only alternative is "Spontaneous Variability!" Well may Darwin say, "We are (he is) far too ignor ant to speculate on the relative importance of the sev eral known and unknown causes of variation." He cannot lay a *foundation* for a theory of development but he is an adept in the erection of a *superstructure!*

He says (p. 351, Vol. 2, *Animals and Plants, &c.*):

"To recur once again to bud-variation. When we reflect on the millions of buds, which many trees have produced, before some one bud varied, we are lost in wonder what the precise cause of each variation can be."

Then after speaking of the improvements which

have arisen in the peach, the plum, the rose, and the camellia, he says:

"When we reflect on these facts, we become deeply impressed with the conviction, that, in such cases, the nature of the variation depends but little on the conditions to which the plant has been exposed, and not in any especial manner on its individual character, but much more on the general nature or constitution, inherited from some remote progenitor, of the whole group of allied beings to which the plant belongs."

This shows that the variations are due to reversion. If they are due to reversion; then, his hypothesis of the community of origin of the species is refuted, because it was by means of these variations, and by means of the assumption, that these variations arose for the first time, that he sought to prove the community of origin of the species. Yet, here he *assumes* the community of origin of the species (which was the *conclusion* at which he professed to arrive by means of the accumulation of variations arising for the first time), to account, by past degeneration and present Reversion, for the appearance of these very variations! Leave out this assumption of the community of origin of the species,—which is the very conclusion which is in dispute(!),—and assume, that the degeneration which has confessedly taken place, has occurred within the limits only of each species; and assume, that the variations, arising in each species, are due to the mere regain of characters lost by such species; and all the phenomena of growth and development will round themselves into a perfect, scientific whole, rigidly exclusive of

all such metaphysical factors as "spontaneous variability," &c.

Darwin evidently sees that, if Reversion may lay claim to all the variations which arise, his theory is at an end. As has doubtless been observed, he strives to show, that Reversion cannot account for "some characters." These "some characters" are the ones upon which hangs his only hope of salvation for his theory. One of the devices, to which he resorts, to confound the problem of reversion, is to appeal to our ignorance of such and such a character ever having been developed before. Deftly playing upon the prejudice of the orthodox, to the effect that God made and placed animals and plants in the existing state of nature, and that therefore it is derogatory to Infinite Power, that He should make any of them in an incomplete condition; he affects to deem it a sufficient answer to the ascription of any variations to Reversion, to refer the reader to the given species as it exists under nature, and to point to the absence, in it, of any such character, as the one in question. When it serves his purpose to refer variations solely to a "spontaneous variability," or to an "innate tendency," he plays the card above indicated. When he endeavors to show the great scope of reversion, he coolly contests any such notion that animals or plants, under nature, need necessarily, to be complete in structure. What involves him in such a mesh of inconsistencies, is that he is endeavoring to arrive at the conclusion, that species had a common origin, by two different sets of premises. By one of the two modes of reasoning, he

strives to show a community of origin of species, by showing that variations have arisen, and that such variations have been accumulated, and have evolved all the different species from one low, primordial organism. This course necessitates the assumption, that such variations arise for the first time. His other design is, to show a community of origin of the species, by showing that the species have been formed by degeneration; and that they are but the various modifications of some higher type than them all. This, on the other hand, requires him to maintain, that such variations as arise, were once fully developed in a type higher in the scale of development, than is the species in which the variations occur. Would it be believed, were not Darwin's works so easy of reference, that on the one side of his problem of the evolution of species, is arrayed a mass of positive evidence, which is well nigh appalling, showing degeneration to have been wide-spread, and to have invaded every known species; while, on the other hand, to offset this antithesis to evolution, is Darwin's mere assumption of an occasional variation occurring, under nature, "once in a thousand generations!" The *degeneration* of each species, under nature, is positive and incontestably attested; whereas, any *evolution* in any species, under nature, is wholly problematical. When such degeneration, in each species, under nature, is so well established, and when the capacity of each species to regain what it lost, is so fully conceded, is not the presumption an overpowering one, viz., that each and every positive variation, or improvement, occurring under domestication,

or under nature, is due to the regain of characters, once lost, by the respective species?

Mark the alternative: If included under the head of reversion, these variations confessedly obey a known, scientific law. If taken without the operation of that law (as Darwin does, without warrant or excuse, and only to save his theory from signal explosion) they must be relegated to what? to "innate tendency," to "spontaneous variability," to "nature and constitution of the being that varies" and to "unknown causes," of all of which "our ignorance is profound." The theory of reversion does not rely solely upon this overpowering presumption; nor upon its competency to cover all the facts; nor upon the absurdity of the alternative explanation (!) of variations. For, it is shown, *aliunde*, that an ancient progenitor of each species, had all the characters fully and proportionately developed. The proof lies in the circumstance, that each and every animal and plant, in the world, is defective (not merely structurally, but physiologically), in proportion as it lacks any positive characters of its species; and that the injury, thereby caused, abates proportionately as it regains the integrity of its species. And then, to round this theory of development, there is the sterility of hybrids!

On page 49, Vol. ii, *Animals and Plants, &c.*, he says:

"When two distinct races are crossed, it is notorious that the tendency in the offspring, to revert to one or both parent forms, is strong, and endures for many generations. I have myself seen the clearest evi-

dence of this, in crossed pigeons, and with various plants. Mr. Sidney states that, in a litter of Essex pigs, two young ones appeared which were the image of the Berkshire boar that had been used twenty-eight years before in giving size and constitution to the breed. I observed in the barn yard at Betley Hall, some fowls, showing a strong likeness to the Malay breed, and was told by Mr. Tollet that he had, forty years before, crossed his birds with Malays, and that, though he had at first attempted to get rid of this strain, he had subsequently given up the attempt, as the Malay characters would appear * * * No rule can be laid down, in cases of a cross, how soon the tendency to reversion will be obliterated * * * But we must be careful, not to confound these cases of reversion to characters gained from a cross, with those given under the first class, in which characters originally common to BOTH parents, but lost at some former period; for such characters may recur, after an almost indefinite number of generations."

Again he says:

"Many sub-varieties of the pigeon have reversed, and somewhat lengthened feathers on the back of the head, and this is certainly not due to the species, under nature, which shows no trace of such a structure, but * * * we may suspect that reversion to some extremely remote form has come into action."

On page 74, Vol. ii, *Animals and Plants, &c.*, he says:

"No doubt it appears, at first sight, in the highest degree improbable that, in every horse, of every generation, there should be a latent capacity and tendency to produce stripes, though these may not appear once in a thousand generations; that in every white, black,

or other colored pigeon, which may have transmitted its proper color, during centuries, there should be a latent capacity, in the plumage, to become, and to be marked, with certain characteristic bars; that, in every child, in a six-fingered family, there should be the capacity for the production of an additional digit; and so in other cases. Nevertheless, there is no more inherent improbability in this being the case, than in a useless and rudimentary organ, or even in only a tendency to the production of a rudimentary organ, being inherited during millions of generations (!), as is well known to occur with a multitude of organic beings. There is no more inherent improbability, in each domestic pig, during a thousand generations, retaining the capacity and tendency to develop great tusks, under fitting conditions, than in the young calf having retained, for an indefinite number of generations, rudimentary incisor teeth, which never protrude through the gums."

Again he says, on page 70, Vol. ii:

"The subject of latent characters is so important, as we shall see in a future chapter, that I will give another illustration. Many animals have the right and left sides of their body unequally developed: this is well known to be the case with flat fish, in which the one side differs, in thickness and color, and in the shape of the fins, from the other; and during the growth of the young fish, one eye actually travels, as shown by Steenstrup, from the lower to the upper surface. In most flat fishes, the left is the blind side, but, in some, it is the right; though, in both cases, 'wrong fishes,' which are developed in a reversed manner to what is usual, occasionally occur, and in Platessa *flesus*, the right or left side is indifferently developed, the one as often as the other. With gasteropods, or shell-fish,

the right and left sides are extremely unequal; the far greater number of species are dextral, with rare and occasional reversals of development, and some few are normally sinistral; but, certain species of Bulimus, and many Achitinellæ, are as often sinistral as dextral. I will give an analogous case in the great articulate kingdom: the two sides of Verucca are so wonderfully unlike, that without careful dissection, it is extremely difficult to recognize the corresponding parts on the opposite sides of the body; yet it is apparently a mere matter of chance, whether it be the right or the left side that undergoes so singular an amount of change. One plant is known to me, in which the flower, according as it stands on the one or other side of the spike, is unequally developed. In all the foregoing cases, the two sides of the animal are perfectly symmetrical at an early period of growth. Now, whenever a species is as liable to be unequally developed on the one side, as on the other side, we may infer that the capacity for such development is present, though latent, in the undeveloped side. And as a reversal of development occasionally occurs in animals of many kinds, this latent capacity is probably very common."

After citing a multitude of instances, showing past degeneration; that characters may long lie latent in the individuals of the species; and the capacity, of such individuals, to regain such characters, whenever the conditions of their development are restored to them; he says:

"From these several facts, it must be admitted, that certain characters, capacities, and instincts, may lie latent, in an individual, and even in a succession of individuals, without our being able to detect the least signs of their presence."

If characters may thus lie latent, "without our being able to detect the least signs of their presence," wherein consists the force of the only objection to ascribing characters to Reversion? namely, that the species, under nature, was never known, by man, to have had characters, similar to those arising by variation?

On page 67, Vol. ii, *Animals and Plants, &c.*, he says:

"Finally, we have seen that characters often reappear in purely-bred races, without our being able to assign any proximate cause; but when they become feral, this is either indirectly or directly induced by the change in their conditions of life. With cross-breeds, the act of crossing, in itself certainly leads to the recovery of long-lost characters, as well as of those derived from either parent form. Changed conditions, consequent on cultivation, and the relative position of buds, flowers, and seeds on the plant, all apparently aid in giving this same tendency. Reversion may occur, either through seminal or bud generation, generally at birth, but sometimes only with an advance of age. Segments, or portions of the individual, may alone be thus affected. That a being should be born resembling in certain characters, an ancestor removed by two or three, and in some cases, by hundreds or even thousands of generations, is assuredly a wonderful fact. In these cases, the child is commonly said to inherit such characters directly from its grandparents, or more remote ancestors. But, this view is hardly conceivable. If, however, we suppose that every character is derived exclusively from the father or mother, but that many characters lie latent in both parents, during a long succession of generations, the foregoing facts are intelligible."

It is difficult to conceive, how any one, who looks this evidence fairly in the face, can entertain the slightest doubt that the cause which Darwin professes to have sought in vain, to explain variations, is furnished by the regain of long-lost characters of the varying species; or, by reversion. The reader will mark, that it is variation which constitutes the problem, not development in general. Development in general, is Darwin's problem; but he chose to solve that problem by the problem of variations. His failure to solve the subordinate problem should alone suffice to demolish his theory of development. *A fortiori*, is his theory destroyed, when there is found a solution of the problem of variations, diametrically opposed to such theory.

To represent, as the author does, that he cannot explain all of the variations or improvements, is to affect an ignorance, simulated under the stress and necessities of his theory. The impression, so widespread and general, that species, taken from a state of nature, are necessarily perfect, after their kind, aids Darwin materially in cloaking the significance of this law of reversion. The current conception, but most erroneous one, is, that all improvements which animals or plants make, after they are placed under domestication, is clear gain, or advance upon what they normally should be. This idea has even been carried so far, as to induce some scientists (?) to maintain, that Providence has introduced something plastic into organisms under domestication, which enables them to vary, in order that they might be of better use to man.

The facts, quoted from Darwin, show that the improvements, or variations, in each species, are but the regain, partial or complete, of an original, normal condition of such species.

On page 447, Vol. ii, he says:

"In every living creature, we may feel assured, that a host of lost characters lie ready to be evolved under proper conditions. How can we make intelligible, and connect with other facts, this wonderful and common capacity of reversion,—this power of calling back to life long-lost characters?"

When he speaks of a "host" of characters, latent in each individual, he is rather overstating the case. But, it places his theory of evolution in a bad light, for it proves that Natural Selection has been engaged in the past, in degenerating organisms, instead of developing them; and, that "the strongest, fittest, and most vigorous," which Natural Selection is said to have preserved, were, instead of being the better for the Struggle for Existence, in a condition only to congratulate themselves, that they were not so completely used up, as were the weakest, which succumbed.

There are not a "host" of such lost characters, in each individual. That is a mere speculative assumption, with Darwin. But, there were a certain number of characters which each species lost under nature, and those characters are represented, in part, by the improvements which arise in each such species under domestication, and at intervals under nature. Even according to Darwin's own showing, there is not a scintilla of evidence, going to prove that one, single,

new character, feature, organ, or instinct—nay, one single cell—has been added to the general organic fund, for "millions of generations" past. His facts demonstrate, that every apparent accession of such, has been the mere regain of what was previously lost, by the varying species, at some near, or remote, period in the past.

Darwin, in combating the view of his adversaries, that the existing state of nature is the same state in which each species was originally created, has pursued a suicidal course; for, in revealing the degeneration which has occurred under the state of nature, and in displaying the extent and scope of reversion under domestication, he has swept the ground from under his feet, by furnishing an explanation of the initial developments (variations), with which his argument starts; and thereby puts an imperative veto on that liberty to extend such developments indefinitely, which the improvements under domestication, at first seemingly gave him. What led to Darwin's giving such a suicidal exposition of Reversion, is this: Notwithstanding that there was, to his theory that the species evolve one from another, the insuperable objection, that the species are effectually divided from each other by the sterility of hybrids, he fancied that he had so far sustained his theory, by the view of an indefinite accumulation of variations, that he might corroborate it by a collateral hypothesis. He fancied that, if he showed that a vast number of characters had been lost, then when different species within the same family, developed each a similar long-lost charac-

ter, it might be argued, that all these species inherited similar characters from some remote, common ancestor from which these several species evolved. But, the mere possession, of a similar character, by several species, does not argue a common origin for them. The turkey, the pigeon, the duck and the chicken, have tail feathers; but this does not prove they descended from a common ancestor. If not, then the loss and regain of such a character by such species, cannot prove it. If proof, *aliunde*, of a common origin, had been adduced; then, the possession, or the regain of such common characters might be advanced as corroborative evidence. If Darwin had shown that improvements, or variations, go on indefinitely, and that therefore it was possible for species to evolve, one from another, this fact of the possession, or of the re-development of a similar character by different species, might be brought in as cumulative proof. But, standing by itself, it has not the weight of levity itself. But, while Darwin thought that he had established the proof, *aliunde*, his collateral hypothesis was sapping that very proof. In attempting to give extra support to his theory, by showing this great degeneration and this ever-active reversion, he undermined his principal theory, by showing that the variations, which his theory required should be extended indefinitely, were due to reversion, and that therefore there was a limit to such variations; which limit conclusively negatived the idea of a community of origin of the species. Another absurdity, in which he involved himself, was by displaying the

fact that, instead of there having been evolution in the past, under nature, there has been great degeneration, which is the very antithesis to evolution. Fancy his assumed, slight variation, arising once in "the course of thousands of generations," and dependent upon the fitful action of Natural Selection for its preservation, contending against the wide-spread degeneration which Darwin shows! And when the variation has arisen, and is preserved, who is to tell, whether or not, it is only a lost character regained?

On page 449, Vol. ii, *Animals and Plants, &c.*, Darwin says, that Herbert Spencer's "*Principles of Biology*" "are not brought to bear on reversion; and this is unintelligible to me." It is not unintelligible to Herbert Spencer. He is a wiser man, in his generation, than is Darwin. He had his own sound reasons for not bringing his principles to bear on reversion. Spencer doubtless saw that his synthesis would be shattered in heaps over his head, by his own act, did he not steer clear of all mention of Reversion. Spencer's synthesis requires that variations should be regarded as wholly ultimate facts, inexplicable by any law save the one which Spencer devised for the nonce, viz., "the instability of the homogeneous." Were it admitted, by Spencer, that the varying individuals have degenerated, and that the appearance, in any individual, of characters similar to the ones which such individual's progenitors lost, must be ascribed to the law of reversion, the inevitable outcome must have been, some day, the complete exposition of the fallacy upon which the synthesis rests. The theory,

that Herbert Spencer saw this, and was loth to contribute to the downfall of his gossamer structure, may alone explain the omission, by a man of his philosophical acumen, of such well known phenomena as are those of Reversion.

On page 77, Vol. ii, *Animals and Plants, &c.*, Darwin says:

"Some flowers have almost certainly become more or less completely peloric through reversion. Corydalis *tuberosa* probably has one of its two nectaries colorless, destitute of nectar, only half the size of the other, and therefore, to a certain extent, in a rudimentary state; the pistil is curved towards the perfect nectary, and the hood, formed of the inner petals, slips off the pistil and stamens in one direction alone, so that, when a bee sucks the perfect nectary, the stigma and stamens are exposed and rubbed against the insect's body. In several closely allied genera, as in Dielytra, &c., there are two perfect nectaries, the pistil is straight, and the hood slips off on either side, according as the bee sucks either nectary. Now, I have examined several flowers of Corydalis *tuberosa*, in which both nectaries were equally developed and contained nectar; in this, we see only the re-development of a partially aborted organ; but, with this re-development, the pistil becomes straight, and the hood slips off in either direction; so that these flowers have acquired the perfect structure, so well adapted for insect agency, of Dielytra and its allies. We cannot attribute these coadapted modifications to chance, or to correlated variability; we must attribute them to a primordial condition of the species."

Is it not rather inconsistent, in an author, according to whose theory, every structure, coadaptation, rela-

tion, and dependency, in organic nature, must, at some time, have arisen by variation, to assert, as Darwin does here, that he is compelled to ascribe the improvements to reversion; because it is so difficult to believe that they have arisen in any other way?

On the same, and on the following page, he cites other startling improvements, which he says, he is constrained to refer to reversion. He also says:

"The case of the fifth stamen, in the peloric Antirrhinum, which is produced by the re-development of a rudiment always present, * * * probably reveals to us the state of the flower, as far as the stamens are concerned, at some ancient epoch. It is also difficult to believe, that the other four stamens, and the petals, after an arrest of development, at a very early embryonic age, would have come to full perfection, in color, structure, and function, unless these organs had, at some former period, normally passed through a similar course of growth. Hence it appears to me probable, that the progenitor of the genus Antirrhinum, must, at some remote epoch, have included five stamens, and borne flowers, in some degree resembling those now produced by the peloric form.

"Lastly, I may add that many instances have been recorded of flowers, not generally ranked as peloric, in which certain organs, normally few in number, have been abnormally augmented. As such an increase of parts cannot be looked at as an arrest of development, nor due to the re-development of rudiments, for no rudiments are present, and as these additional parts bring the plant into closer relationship with its natural allies, they ought probably to be viewed as reversions to a primordial condition."

These quotations, from Darwin's works, showing

Reversion, might be multiplied indefinitely, for he gives several chapters to the subject, and almost every other page of his works, is filled with references to this factor. With one more quotation we will close the direct proofs of Reversion.

On page 80, Vol. ii, *Animals and Plants, &c.*, he says:

"On the doctrine of reversion, as given in this chapter, the germ becomes a far more marvelous object; for, besides the visible changes to which it is subjected, we must believe that it is crowded with invisible characters, proper to both sexes, to both the right and left side of the body, and to a long line of male and female ancestors, separated by hundreds, or even thousands, of generations from the present time; and these characters, like those written on paper with invisible ink, all lie ready to be evolved, under certain known or unknown conditions."

Assume but a tithe of the degeneration, which is above implied, and the scope of reversion is sufficiently wide to cover every variation, under domestication, or under nature. Darwin's theory lays claim to be a tenable hypothesis, only in the event, that variations are inexplicable, and may proceed forever, or indefinitely. This assumption of his, is, however, completely negatived by the facts of Reversion, which show that the sole variation possible, is the regain of characters lost, and that when all of the characters, which any species has lost, have been recovered, the limit of positive variation, for that species, is reached.

If it be conceded, that proof of a glaring *hiatus*, intervening between a theory and the facts upon which such

theory purports to rest, invalidates that theory; and, if the filling up of that *hiatus*, with a known, scientific law, diametrically opposed to the assumption essential to such theory, is disproof of the theory; then, the evidence already advanced, constitutes a Refutation of Darwinism. But, the Refutation does not depend upon such mere agreement, of the facts, with the hypothesis of Reversion. Demonstrative proof of the truth of the theory of Reversion is readily available; which is furnished, in the subsequent chapters, which treat of Crossing, Close-Interbreeding, and Self-Fertilization.

CHAPTER IV.

REVERSION NOT A LAW, *Sui Generis;* BUT A DERIVATIVE LAW, ASSIMILABLE TO OTHER WELL KNOWN LAWS.

We have shown Reversion to be a most potent factor, and proven it to be abundantly able to explain every improvement which has arisen, or which may arise, under Nature, or under domestication. Although it does not explain the origin of the development of each species, it does explain, clearly and fully, what that phase of development is, which, in Biology, has been termed Progress. It does explain,—and explains them in a manner inconsistent with Darwin's theory,—all those slight increments or gradations of growth, called variations or improvements, upon which Darwin endeavors to base his theory.

As heretofore used, the word, Progress, has been simply a metaphysical entity, with as little title to recognition, by science, as have "innate tendency," "inherent aptitude," "vital force," or any of those other, barren terms by which men have shaped ignorance into the semblance of knowledge. There is a law of Progress; but that law, when rightly resolved, is Reversion, or the regain of characters, organs, faculties, instincts and powers which were once lost by the species, now progressing. Thus regarded, Progress is

a positive, definite, scientific factor; founded upon well established physiological principles, not upon chance, as it has heretofore been, nor upon a "tendency," nor upon any metaphysical entity, or other makeshift of ignorance, nor upon any obscure, fatalistic hypothesis. The advocates of Progress need not abate any of their enthusiasm, for their cherished watchword; for, in each species, and notably in Man, there still remains a wide margin for improvement.

There are, also, four other laws,—three of which are most familiarly known to the vulgar, as well as to the learned,—with which, the identity of Reversion is possible to be fully established. (1). One is the capacity of redintegration, following the disintegration of the tissues. (2). Another is the power of reparation which is manifested, either by what is termed, healing by first intention, or healing with inflammation, upon the occurrence of any wound or abrasion. (3). Another law, with which Reversion is identical, is the power of immediate reproduction of a lost member; a power which is displayed, to the fullest extent, by the lower orders of animals, and, measurably, by even the highest. (4.) The fourth and last law, is Generation, both sexual and asexual.

Of the first,—viz., the repair which is continually making good the waste of the tissue in the organic system,—no evidence is needed, as it is well known by physiologists; and, even the unlearned, in science, attest their knowledge of it, in the current conception, that the body undergoes a complete change, every seven years.

Of the second law, Darwin speaks, at much length, in Chapter XXVII, of Vol. ii, of *Animals and Plants, &c.* This law, also, is matter of common knowledge.

Of the third law,—viz., the reproduction of lost limbs, in the course of the same generation in which they were lost,—evidence perhaps may better be produced, as it is a matter not so generally known.

"It is notorious" (says Darwin) "that some of the lower animals, when cut into many pieces, reproduce so many perfect individuals. Lyonnet cut a Nais, or freshwater worm, into nearly fifty pieces, and these all reproduced perfect animals. It is probable that segmentation could be carried much further in some of the protozoa, and, with some of the lowest plants, each cell will reproduce the parent form" (pp. 429, 430, Vol. ii, *Animals and Plants, &c*).

The power of this reversion, or ability, of any organism to recomplete itself, when any part or parts have been cut off, is such, that a mere fragment, taken from a Begonia leaf, will re-develop the whole plant, if imbedded in fit soil, and kept at an appropriate temperature. So small, frequently, is the fragment which is capable of reproducing for itself the whole plant from which it is torn, that something like a hundred plants, may be produced from the fragments of a single leaf. If this power be kept down by adverse conditions, is it any wonder that, upon the return of the favorable conditions, to a plant which has had a part or organ missing for ten, a hundred, or a thousand generations, it should regain its integrity, by re-developing such part or organ?

"Now, when the leg, for instance, of a salamander, is cut off, a slight crust forms over the wound, and beneath this crust, the uninjured cells, or units of bone, muscle, nerves, &c., are supposed to unite with the diffused gemmules of those cells which in the perfect leg come next in order; and these as they become slightly developed, unite with others, and so until a papilla of soft cellular tissue, the 'budding leg' is formed; and in time a perfect leg. Thus, that portion of the leg which had been cut off, neither more nor less, would be reproduced. If the tail or leg of a young animal had been cut off, a young tail or leg would have been reproduced, as actually occurs with the amputated tail of the tad-pole" (pp. 450, 451, Vol. ii, *Animals and Plants, &c.*).

"Spallanzani, by cutting off the legs and tail of a salamander, got in the course of three months, six crops of these members; so that 687 perfect bones were reproduced, by one animal, during one season. At whatever point, the limb was cut off, the deficient part, and no more, was exactly reproduced. Even with Man, as we have seen in the twelfth chapter, when treating of polydactylism, the entire limb, whilst in an embryonic state, and supernumary digits, are occasionally, though imperfectly, reproduced after amputation. When a diseased bone has been removed, a new one sometimes gradually assumes the regular form, and all the attachments of muscles, ligaments, &c., become as complete as before" (p. 354, Vol. ii, *Animals and Plants, &c*).

"No doubt, the power of reparation, though not always quite perfect, is an admirable provision, ready for various emergencies, even for those which occur only at long intervals of time" (p. 355, Vol. ii, *Animals and Plants, &c*).

In all of these cases of repair, or reproduction, the

integrity of the organism has been impaired; and, "the coördinating power of the organization" has repaired such integrity. Darwin speaks of this power, as the

"Reparative power which is common, in a higher or lower degree, to all organic beings, and which was formerly designated by physiologists as the *nisus formativus*" (p. 353, Vol. ii, *Animals and Plants, &c*).

Now, Reversion is, essentially, the same power. It is but a manifestation of the same law; only, not occurring in the same generation, with that in which the integrity of the organism, was impaired. The only difference is, that, in the case of reintegration of tissue, in the case of repair of wounds, and in the reproduction of a lost limb, the impaired integrity, consequent, respectively, upon the disintegration of the tissue, upon the infliction of the wound, and upon the dismemberment, is immediately retrieved; while, in Reversion, the return to such state of integrity, is deferred, for one or more generations, owing to unfavorable conditions,—the same conditions, generally, which entailed the loss, or the reduction, of the given part. The relation which Reversion bears to the healing of a wound, is, essentially, that which this same healing, when attended by inflammation, bears to this same healing, when it is effected by what is termed, "first intention." As, the immediate healing of a wound has been thus termed; and, as it is manifestly implied, that healing, by inflammation, may be called healing by second, third, fourth, fifth, sixth, or twentieth intention; so, Reversion might consistently

be termed, hundredth, thousandth, or ten thousandth intention; according to the interval of time, during which, the characters, eventually regained, have remained reduced or suppressed.

The mistake, made by those who have advocated the evolution of the species, has been, in placing the fixed type,—that is, the organism, which is in its full, normal integrity,—in those individuals of the given species, which have the average structure of the species, as it exists under nature. The type there, now, however, is a degenerated type, with its structural integrity impaired, by the loss of some characters, and by the reduction of others; and, the type of the given species is not fixed under the existing state of nature. It is fixed (*i. e.*, normally fixed), at a certain margin of development, above such structure as it subsists in the state of nature. The improvement, in each species, under domestication, is a margin, merely, corresponding with the margin of previous degeneration. The characters which arise, do but resume their lost, structural integrity, as characters do, when reproduced in a truncated salamander. The fact, that function takes precedence of structure, should suffice to indicate that the power displayed, is Reversion.

All of these powers, of repair, are Reversions to the primordial integrity of the given organism's species. The Reversion, which is especially so called, is solely a different manifestation of the same power which, in nutrition, replaces the disintegrated tissue; of the same power, which repairs a wound, or a bruise; of the same power, which shows itself in the reproduction of a lost

member;—the only difference being, in the amount of time taken to operate. In the one case, the reintegration occurs immediately, or in the same generation, in which the loss of structural integrity occurred; and, in the other case, the reintegration is deferred, owing to the absence of favorable conditions, for several, or for many generations.

"It is notorious," says Darwin, "and we shall immediately adduce proofs, that increased use or action strengthens muscles, glands, sense-organs, &c.; and, that disuse, on the other hand, weakens them. I have not met with a clear explanation of this fact, in works on Physiology. Mr. Herbert Spencer maintains that, when muscles are much used, or when intermittent pressure is applied to the epidermis, an excess of nutritious matter exudes from the vessels, and that this gives additional development to the adjoining parts."

It may be remarked, *en passant*, that Mr. Herbert Spencer never yet failed to explain (?) any phenomena, where language was capable of converting a mere restatement of the facts, into the semblance of a *vera causa.*

The greater efficiency in function, and the greater development in structure, which follow greater activity, are fully explicable, upon the view, that this greater efficiency and greater development, were once part of the perfect coördination of the organism, either in the individual itself, or in its ancestors; that the organism has degenerated; and that the organism has ever been striving,—as Darwin asserts Reversion to be ever striving, in the offspring of each successive generation,—to bring into

play its reparative power, or *nisus formativus*, in order to restore the lost integrity. The greater activity does not *cause* the functional, or structural increase. That is but a condition. The absence of such activity has atrophied, or reduced the organ. The subsequent restoration of such condition, occasions the re-development. There is but one normal coördination of the parts of any one species. The absence of any part, or organ, impairs such coördination. By disintegration; by the loss of tissue, consequent upon a wound; or, by the loss or reduction of a character or organ, either suddenly by dismemberment, or by the slow operation of adverse conditions, this coördination is rendered abnormal. Perfect coördination is compatible, only with the sum of all the characters and parts, of a species, fully and proportionately developed. When all the parts are present, and the full complement of tissue is realized, in the individual, the coördination is active, perfect, and normal, in each and every part. When a part is missing, impaired coördination results; but, the remaining parts are correlated to the parts missing; and this correlation, being essentially a coördinating power,—which acts equally when a part is missing, or present,—the reintegration of the lost part results, when the conditions allow. The same force which binds the given part, when present, to the whole, restores it when lost. If a number of parts be missing, or reduced, and the conditions (increased activity, &c.), be exclusively propitious to the re-development of one of such parts; then, that part alone will develop.

The finger-reading of the blind; the exalted ability of an orchestral conductor, to discriminate delicate differences of sound; the pronounced development of a dancer's legs, and of the jockey's crural adductors; the many instances of high cultivation of the senses, and of the intellect, either special or general; attest,—not a development, caused by mere activity,—but the reparative power, which follows, very late, upon a degeneration suffered by the individual's ancient progenitors. Had the said tactual ability of the blind, and the other cases of development, been at their maximum, in an individual; and had they, then, from some cause, been lost; their regain, by means of the *nisus formativus*, or reparative power, would be considered perfectly natural. Why, then, should their restoration to full integrity, and to full power, be deemed in anywise singular, when Darwin himself testifies, that this reparative power is operative, with the largest and most important organs, after thousands, and even millions, of generations? As a fact, this functional and structural development does ensue upon mere activity. But the activity is but the mere *condition*. The cause is to be sought, elsewhere. To explain it; which is the more scientific and reasonable?—to refer it to "evolution," to "progress," to "innate tendency," etc., terms which are, confessedly, but the mere symbols of a cause unknown; or, to ascribe it to a power, which we see daily in operation, in the repair of the slightest injury to the skin?

If an individual should forswear all manner of exer-

cise of his crural appendages, those members would become, either atrophied, or greatly shrunken in size. If, then, he were to indulge in judiciously-increased activity, they would regain their normal, functional, and structural integrity. This regain will not, then, be caused, by such increased activity; but, by the coördinating power of the organism, which ties together all the parts, and which, of itself, never normally changes; but which is changed, or modified, in its efficiency, by the absence of the condition, needful for the exercise of its power. It thus changes and the minimum of such change, to which it is subjected by external conditions, is, doubtless, that flux which it experiences, when the usual process of the disintegration of tissue, is taking place. We are engaged, now, only in establishing our assumption that, after primal Evolution, the only kind of development, or of growth, possible, is Reversion, which is the regain of a species' lost integrity; but it is the purpose of this work, to demonstrate, that the only, normal state of this coördinating (or as some may call it, vital) force, is the state in which it is in the maximum degree of efficiency, possible for any individual of the given species;—and that, within any given species, it is impossible to have any other, normal coördination of parts, than that coördination which comprises all of the characters of such species. All of the differences, between individuals of the same species, are due to the different manners and degrees in which this full integrity of the organism, has been modified; together with the different modes and de-

grees in which their power of reversion to the full structural build, has been modified by their conditions of life.

That reversion is ever ready to operate,—as are the other powers of repair, in the case of a wound, in the case of interstitial waste, and in the case of the reproduction of a lost member,—Darwin shows, when he says (p. 483, Vol. ii, *Animals and Plants, &c.*):

"That there is a tendency, in the young of each, successive generation, to produce the long-lost characters, and that this tendency, from some unknown cause, sometimes prevails."

This Reversion is, equally with the other powers of repair, but a process of redintegration; and, between it and the others, there is no fundamental distinction. All of the instances, which he adduces, of improvement or positive variation, are merely instances of such reintegration. When Mr. Darwin has furnished his thousands of facts, he has not yet given a scintilla of proof, or of evidence, of the indefinite development of any species. For, all of the improvements, and all of the positive variations, adduced by him, are but regrowth, redintegration, and repair merely, of the specific type; and, upon no principle of logic, or of common sense, may instances of regrowth, or of reintegration, or of repair, or of re-development, or of reversion, serve as *data*, for any theory of unlimited growth, or of unlimited development; for the limit of this repair, reintegration, or reversion, is the form respectively, of the structure, from which the organism, in question, departed. How repair, re-growth, regain, re-develop-

ment, reproduction, reversion, or redintegration, can, by any possibility, justly enter, as an element, into a process of development, designed to prove unlimited growth, unlimited development or unlimited integration, is a mystery, to every one acquainted with the canons of logic. Darwin has collected, from various sources, a great number of interesting facts; and has thereby rendered a great service to science; but, if he had devoted a tithe of the labor, and of the time, to showing the relevancy of those facts, in connection with his theory, he would have furnished his readers, with something of infinitely more value than facts.

He has, however, ingeniously availed himself of an erroneous notion of his adversaries; namely, that, as the state of nature was the state in which the Creator placed the Animals and Plants, when He created them, therefore, the structure, as existing now, in the state of nature, must be the normal, perfect mould,—which is a glaring *non sequitur*. Darwin, however, though he does not believe in any such alleged, normal structure, derives a great, temporary benefit from the said mistake; for, it allows him to argue thus: If the structure, of any animal or plant, as now existing under nature, is the normal build, then the variations occurring under domestication, are something over and above the development which the Creator established: If so; then, who is to say, that there is a limit to such residual development? And, if so, it is probable, that the Creator never fixed any structure for any species; but, instead thereof, the species have gone

on developing, by means of slow accretions, such as we perceive under domestication.

A most clever trick! He accepts, provisionally,—although not concurring in,—the truth of his adversaries' assumption; he is suffered, then, to work in his false hypothesis (which he would never have been allowed to do, if his adversaries had not been in error in their said assumption); and then arrives at his conclusion, which negatives completely the assumption by which alone it was possible for him to achieve it!

The identity of the several powers, is well shown by the two following quotations, from Darwin's *Animals and Plants, &c.*:

"Between the powers, which repair a trifling injury in any part, and the power which previously was occupied, in its maintenance, by the continued mutation of its particles" (*i. e.*, the reintegration of the tissues), "there cannot be any great difference; and we may follow Mr. Paget in believing them to be the self-same power. As at each stage of growth, an amputated part is replaced, by one in the same state of development, we must likewise follow Mr. Paget in admitting, 'that the powers of development from the embryo are identical with those exercised for the restoration from injuries'" (p. 430, Vol. ii).

These remarks show the identity of all the powers of repair, which operate in the same generation in which the organism suffered the departure from its proper type. The following quotation, from Darwin, shows, that the repair which occurs in the next, or succeeding generations (that is, Reversion, or appear-

ance of improvements) is also identical with the other powers of returning to the perfect type:

"No doubt the power of reparation, though not always quite perfect, is an admirable provision, ready for various emergencies, even for those which occur only at long intervals of time" (p. 355, Vol. ii).

In speaking of the power of reproduction of lost members, he says:

"This power of regrowth does not, however, always act perfectly; the reproduced tail of a lizard differs in the forms of the scales from the normal tail" (p. 354, Vol. ii).

So, with the improvements, arising in animals and plants under domestication; this *nisus formativus*, this reparative power, or Reversion,—as it is especially so called, when it occurs in a generation following that in which the injury was caused, or the characters were lost,—does not always retrieve, in a complete or perfect state, the characters which were lost by the species. The conditions are not perfectly supplied. When they are perfectly supplied, there will be perfect reparation, perfect reversion, in those animals and plants, as well as in the lizard.

This "power is greater in animals, the lower they are in the scales of organisms," says Darwin (p. 354, Vol. ii, *Animals and Plants, &c*).

The reason of this lessened reproductive power, in the higher animals, is, that such animals are more complex, the conditions of growth are correspondingly more complex, and less easily supplied; and, therefore, lost members are less likely to be supplied, when

required. The power, however, ever potentially exists in these higher animals; and (with but an abatement, in degree), actually exists, in the power of repair of wounds, of reintegration of tissue, and also manifests itself through Reversion. Darwin quotes quite a number of authors who, to explain variability, have formulated a law, *sui generis*, which absolutely requires offspring to differ, in some degree, from their parents. This is absurd. Facts are noticed; no explanation can be furnished to explain them; and then some genius always steps forward, and complacently declares that it is a "*law of nature*," that the phenomena should so be, or so act; and fancies, that he has thereby added immensely to the body of scientific knowledge. No such "law" is formulated here. The explanation requires no such hypothetical, and barren device, fashioned for the nonce. The offspring, when they differ, in some positive character, from their parents, differ, because their reparative power, or capacity to retrieve characters, which were lost by some ancient progenitor, is, in the said character, manifested more strongly, than it was, in their parents. Offspring, when they differ, in some negative character, from their parents, differ, because they, in that character, depart further from the original and perfect type than their parents have done. Their coördinative power has been more weakened than has that of their parents; or, than has that which their parents inherited.

That there is but one, normal mould, for the individuals of any species; and, that the coördination of

an organism is normal, only when it has all of the positive characters of its species to coördinate; and, is impaired, proportionally, when there is any disintegration, or loss or reduction of any of the characters of the given species; are necessary inferences from the following assertion:

"This subject has been here noticed, because we may infer, that when any part or organ is either greatly increased in size, or wholly suppressed, through variation and continued selection, the coördinating power of the organization will continually tend to bring all the parts again into harmony with each other" (p. 355, Vol. ii, *Animals and Plants, &c*).

Had Darwin adhered to this principle, in his treatment of the facts of variation, and of breeding, he would never have propounded a theory of the evolution of the species, from one another. For, it shows that, with each species, there is a certain ratio of development of its several characters, which cannot normally be varied from. How was it possible for him to be apprised of this principle, and yet fancy that each variety (of the Pigeon, for instance) could normally and safely diverge, as it has, both through having a part, or organ which constitutes its peculiarity, greatly increased in size; and by having others wholly suppressed? and, how could he ignore the facts, that the evil results of close-interbreeding, in the pigeon, are due to this very disproportionate development, and that the good, which results from crossing, is due to the parts again being, measurably, brought into harmony with each other? Are not the varieties of the

pigeon, each, possessed of a character, of the species, which the others lack? and does not each such variety lack all of those characters of the same species, which respectively constitute the peculiarities of the other varieties? Is not, then, "the coördinating power of the organization" impaired, by such great increase of the one part, and by the suppression of the other parts? Does not the reduction in the pig, of the snout, tusks, bristles, legs, tail, &c., militate against this "tendency" of "the coördinating power of the organization," "to bring all the parts again into harmony with each other?" Assuredly, the evil results from close-interbreeding the individuals of these varieties, would imply as much; and, the decline in the measure of those evil effects, when the individuals have all the parts again brought into harmony with each other, looks as if the principle of his, above quoted, was pregnant with more consequences than he has anticipated. Upon what hypothesis, other than that, which holds it necessary to have all of the characters, of a species, developed in each individual, is this "coördinating power of the organization," to be explained? This coördinating power is the bond, which links all the parts of the species together; and, it operates, in Reversion, by again bringing them together, when they have been lost. The same principle holds good, in the slightest wound, and in interstitial waste; the coördinating power reintegrates the parts, and restores the type of the species; and, all of these powers are but different phases of the one process of coördination.

Darwin's remark, that that portion of the leg of the salamander, which was cut off, "*neither more nor less*," will be reproduced, is, *mutatis mutandis*, applicable to the improvements, or variations, under domestication. Those characters only, no more (though possibly less), will be regained, by a species, which were at one time lost by such species. The like remark, which he makes, when he says, the deficient part, and *no more*, was reproduced, is equally pertinent to the variations which arise. Parts only which are deficient, or absent, where they were once developed, can be acquired, by Man's selection, or by Natural Selection.

To illustrate the absurdity, of taking any of these cases of Reversion, as the basis of an indefinitely-continued development, which is to produce higher animals from lower ones, we shall take the case of redintegration, in the crystal.

It is well known, that, if a crystal has had one of its edges cut off, and the crystal is placed in a solution, similar to that, in which it was first formed, it will reproduce the lost edge, and thus repair its lost integrity. When the edge was absent, there was an imperfect equilibrium of the forces of the crystal. When the coördinating power of the crystal, restored the lost edge, the equilibrium, or coördination, was repaired. The restoration of the part, before cut off, was effected, by correlation with all the other parts, and with the aggregate. The part reproduced, resumes its relations to the other parts, and to the aggregate; and effects a return to the balance, which was impaired by its absence. The reproduction of a part, by the

crystal, is precisely analogous to reversion, to the reproduction of a lost member, to the reintegration of tissue, and to the repair of a wound or abrasion. Darwin merely mentions, that he has heard this reparative power of the crystal, likened to the repair of a wound, in an animal. Herbert Spencer also refrains from any extended allusion to this power in the crystal; doubtless, from distrust of the effect its implications would have, upon his hypothesis.

This analogy most happily illustrates the absurdity, of Darwin's adducing the phenomena of variation, to prove the evolution of the species.

Suppose the same crystal, truncated of its edge. With this edge gone, the crystal is found by Darwin. He places it in a solution, similar to that in which it was first formed. The reproduction of the lost edge, then ensues. He inquires the reason, why this part of the crystal has developed. To this he can answer, only that it develops, because it has an "innate tendency" so to develop. (As Ancient Pistol has it, "*Semper idem, absque hoc nihil est.*") He affects to believe himself forced to conclude that the growth of the edge, is an ultimate fact. He then says that as this development has taken place, he is entitled to the presumption that it will continue forever, or indefinitely. Given, then (he would by analogy, say), a thousand years or a thousand hours; and who is to say, into what, this crystal will not develop? and, may not each of the species, of crystals, evolve one from another? You cannot assume a limit (he would say), other than gratuitously. There cannot, possibly, then,

be any such thing as the immutability of the species, of crystals; for, the individual crystals vary, and the species is made up of such individuals.

Such an argument could not be invalidated, if it were conceded, that the growth of the lost edge was absolutely new growth, and that it was not mere repair, or mere reproduction. It is obvious, however, that it is repair only, or reproduction, or Reversion back to the state which existed, in the crystal, previous to its truncation. It is equally obvious, therefore, that there is in the said crystal, no such capacity for unlimited growth, or integration, as Darwin would allege to exist in organisms. It is equally obvious, to a mineralogist, that those forms, of the crystals, which have not been truncated, are normally immutable;—that is, that no change can take place in them, after they have once assumed their specific, determinate form, save in derogation of that peculiar segregation, or coördination, of forces which make up a crystal. It is equally manifest, that all of the different kinds of crystals, ranging from the simplest to the most complex, are not evolved, one from another; that their beautiful subordination, of group under group, which rivals the arrangement of organisms, is no argument, whatever, in favor of a view, that they evolved from one another. They, each and every one, on the contrary, were evolved from independent centres,—centres, possibly, in the same matrix, yet perfectly independent centres, so far as the processes of integration are concerned. The initial force, involved in the deposition of the first molecule, pre-determined the form, shape, and

complexity of the crystal, and controlled the whole formative process, for that crystal. It is equally manifest, that, when the integration, of the crystal, is once fully attained, there is a peculiar play, and correlation, of the forces of the crystal, which constitute a coördinative power, invested with the capacity, to keep all of the parts together, and capable of repairing any part, when lost or injured.

It may be well to state, that the organic species, is not the analogue of what is termed a species, in crystals; but, it is the analogue of those forms, which are absolutely alike, when they are not injured, or truncated. Thus, the flowers of snow, in crystallographic parlance, are termed a species. These, however, do not correspond to an organic species, but, rather, to an organic genus; it is those of the flowers of snow, which are precisely identical, in shape and form, cleavage, &c., which are analogous to a species of animal or of plant.

These different flowers of snow did not evolve, from one another, but they commenced, and completed, their integration, independently of the others. No similarity can, with them, afford an argument in favor of their evolution, one from another. So, with species of animals and plants. They were evolved, specially, each from an independent centre. Neither, the similarity of different species, nor their natural subordination, group under group, justly implies that they evolved, one from another. Kinship is not necessarily the bond, between the individuals of the same species. The only necessary tie between them,

is an identical, normal coördination, however derived, whether by descent, or by independent evolution. Organisms, to be of the same species, need not, necessarily, to be descended from a common progenitor; all that is required to class them, within the same species, is to ascertain if their normal coördinations are isochronous. If they have the same number of characters, and the same ratio of development of those characters, when they are free from physiological defects, they belong to the same species. The test by which to determine whether they are free from physiological defect, and of full integrity, is to be found under our chapters, upon Crossing and Close-interbreeding. Near similarities, and such arrangement, group resembling group, may imply, and doubtless do imply, that different species were evolved from a similar matrix, and under similar conditions.

The variations under domestication, are the same with the repair of a lost edge in a crystal,—simply, a regain of lost integrity. With an organic species, however, the individuals composing it are descended, one from another; while, even the individuals, of what, in crystals, is a species, by analogy, are evolved from independent centres.

He says (p. 486, *Origin of Species*):

"From the first dawn of life, all organic beings are found to resemble each other in descending degrees; so that they can be classed in groups under groups."

So, crystals are likewise "found to resemble each other in descending degrees, so that they can be classed in groups under groups;" yet, they were not

evolved one from another; but were evolved, each, from an independent centre. Crystals also, may be modified, as are organic beings under nature; and, like them, such modification will be injurious to the coördination of their forces. They will also regain a lost edge, as well as organic beings will acquire, by reversion, a lost character; and, in proportion as they repair their lost edges, will their coördination approximate its normal type; the same as will the coördination of an organism be repaired, in proportion as Reversion restores the lost characters. Although you may truncate each individual crystal, after it has attained its full integrity, you do it only in derogation of its coördinating, crystallogenic force.

These crystals occur of all sizes, from the merest microscopic point, to a yard, or more, in diameter, and of all degrees of complexity. A single crystal of quartz, now at Milan, is three and a quarter feet long, and five and a half feet in circumference, and its weight is estimated at 870 pounds. Each mineral has its own mode of crystallization, by which it may be distinguished, just as one distinguishes a genus of plant, by its characters, and mode of growth. And it is known, at once, to a mineralogist, of what mineral, a crystal is formed, wherever it may be found, by its angles, and by peculiarities of internal structure, such as its lines of cleavage. A variety of forms is often presented by a single mineral; and this variety may be very great, as with Calc-spar which is found in double pyramid, in prisms, and in rhombohedrons; and so with other species, as they are called; although only

those individuals of exactly alike form, and with all their features in common, are, by analogy, with organic species, to be termed species. But, however great the number of all the forms in each case, they are referable to a single, generic, or family type, and little skill is required to trace out extreme simplicity amid apparent complexity, for all the various modifications are arranged in beautiful order.

Why are they so arranged? If a mineralogist should argue, as Darwin argues from a like due subordination of group under group, in descending complexity, he would contend for an absurdity; and hold, that they were evolved, the more complex from the simpler. The fact, however, is—not that they were evolved from one another—but that they started from independent centres, and that the degrees of similarity between them, is referable to the circumstance, that they were independently evolved from the like, or the same mineral, and were subject to like conditions of temperature, &c. The initial force, implied in the deposition of each molecule of each crystal, pre-determined a regular, definite structure, and compelled a form which needed to be attained, or, the correlation of the forces involved in the crystal would have been thrown into disorder, and the forces involved in the crystal would have become so much the less crystallogenic in character. A truncated crystal may have been long out of a solution; yet, if restored thereto, it will repair the lost part. If a mineralogist should meet with such a truncated crystal, he, being unconscious that it was truncated, should restore it to a solution,

and should proceed to estimate a ratio of integration for that crystal, based upon his observation of the degree of reparative power displayed before his eyes; he would be the perfect analogue of Darwin, who takes truncated organisms, places them under domestication, observes their power of repair, or of Reversion, and then absurdly essays to estimate, what would be the development of such organisms, if a few millions of years were assumed.

No crystal, nor organic species, is possible to be normally modified, after it has been once evolved. You may truncate the crystal; you may deprive the organic species of many of its characters; but a disturbance of the integrity of the forces involved, in either case will inevitably result. The only way, either to modify a crystal normally, or normally to change an organic species, is to resolve either into its original elements, then modify the forces primarily involved in its integration, or evolution, and start a new integration or evolution. That, however, is tantamount, with an organism, to new creation; or to primal evolution from inorganic forces and matter. The test of any abnormal modification of a species, is close interbreeding. The principal differences between a crystal and an organism are: (1). That a crystal is not susceptible to that ebb and flow which we find manifested in an organism, in the waste and repair of its tissue. (2). That the crystal, though capable of integrating a like form when a portion of its substance is detached by force *ab extra*, is not capable of spontaneously exuding or detaching a portion of its substance for the

purpose of forming a new, like coördination; as, is an organism, when it evolves, or exudes sexually, or asexually, a reproductive element.

Not a little prejudice exists against a perfect type. This prejudice is, in a measure, justified; owing to the vague and gratuitous manner in which it is generally assumed,—and, owing to the fact, that those, assuming it, cannot give any definite idea of what they mean by it. But, such prejudice cannot be extended to the perfect type, which we show. This of ours, is an individual in which all the characters of its species, are fully and proportionately developed. It is no Platonic idea; and is no more metaphysical, than the assumption of a specific shape, for a truncated crystal, which, at the time, falls short of that shape, in the matter of a lost edge.

Thus, we have furnished, at least, warrant for assuming, that there is but one coördination, which is normal, for each species; that, when the structural integrity, of any individual, is impaired, such coördination is proportionally impaired; that this coördination is capable of restoring the lost, structural integrity; that the reintegration of tissues wasted by function, that the repair of a wound, that the reproduction of a lost member, that the regain of characters lost in some preceding generation, and that the reproduction of a lost edge in a crystal, are all merely different phases of one and the same power,—*i. e.*, the power, of any body whose parts are correlated together with reference to a definite form of structure, to recomplete itself, when any of its correlated parts have, by influences *ab extra*, been reduced or suppressed. As before intimated, we do not rely

upon the mere capacity of the assumption to explain all of the facts. Proof, approximating demonstration, is to be found in the chapters on Crossing and close-interbreeding, where a crucial test is furnished, by which it is possible ever, to ascertain, with respect to organisms, whether the structure is complete, and whether the coördination is of full integrity; or, how far such structural integrity, and such full, normal coördination have been departed from. Before proceeding to develop this test, it is incumbent upon us to show what a *petitio principii*, the argument from Natural Selection (Darwin's potent factor) is.

It is possible, also, to establish the similarity of the Law of Generation, with that of Reversion. Generation is, equally, a process of repair. A portion of an organism is exuded by an individual, and this portion at once proceeds to complete, for itself, the type of the given species. The reproductive element differs but little, essentially, in its operation, from the part (spoken of by Darwin), which is cut off from a Nais, or fresh-water worm, and which then reproduces the whole. The only difference lies in the manner in which the parts are separated from the parent organism, and in the necessity which, in some modes of Generation, there is, that the reproductive element should be united to that of the other sex.

The point, sought to be illustrated, is, that every mode of growth and of development (save that process which controlled the evolution of the first member, or members, of each species), is but a regain of the lost integrity of the given species.

CHAPTER V.

The Fallacies of Darwin's Argument from Natural Selection.

It is possible, without, in the least, questioning the potential efficiency of Natural Selection, to show that Darwin's argument from Natural Selection begs the whole question at issue. For it gratuitously assumes that the variations (which Darwin would have Natural Selection to preserve and accumulate to an indefinite or unlimited extent) are not restricted to the number and kind which the varying species once lost.

Darwin says, that the higher species have been evolved from the lower, by means of the preservation and accumulation of slight, successive increments of development, and by means of the preservation and accumulation of those marked variations which are assumed to spring up mysteriously, under nature, "once in the course of thousands of generations."

The reader will perceive that there are thus two ways in which Darwin gets the units of development which, he purports to prove, are accumulated indefinitely, or without limit.

The one mode is by attempting, by argument, to *prove* that slight advances in development necessarily result from Natural Selection. Under nature, there has been

ever recurring, he alleges, a fearful struggle for Existence (brought on by adverse conditions, want of food, and the severe competition consequent upon the ratio of increase of living beings), in which the weak succumb, and "the strongest and most vigorous" survive. These "strongest and most vigorous" being the ones, exclusively, which continue the line of descent, increase in development, he contends, must obviously follow. The indefinitely-continued accumulation of increments of development so occasioned, explains, he says, the process by which the lower species have been evolved into the higher.

Darwin's other mode of getting units of development for Natural Selection to accumulate to an indefinite extent, is, not by any argument from Natural Selection, but by *assuming* that marked variations—similar to the "sports" which appear under domestication—arise under nature, at least once in the course of thousands of generations. Then he contends that Natural Selection preserves and accumulates these marked variations to an unlimited or indefinite extent, and so evolves the species one from another.

Now, it is intended to show, in this chapter,

First: That Natural Selection, or "the survival of the stronger and more vigorous," does not *prove* any, even the slightest advance in development, or any, even the slightest variation.

Second: It is intended to show that even though slight advances in development, or variations, were proven by "the survival of the stronger and more vigorous," or were proven in any way; and even though

Natural Selection were proven to be perfectly competent, in itself, to preserve and accumulate such advances in development, or such variations; the accumulation of such advances in development, or such variations, by means of Natural Selection, could not proceed to the extent necessary to evolve one species into another, because the presumption—which arises from Darwin's very detail of the operation of Natural Selection—which arises from the many rudimentary organs adduced by him—which arises from the many features which he admits have been reduced or simplified by the action of the conditions of Natural Selection—which arises from the many characters which, Darwin says, have been so wholly suppressed, under nature, that not a vestige of their past development remains—which arises from the multitude of organs and features which he confesses are due to Reversion—and which arises from the fact that there is, confessedly, no other scientific explanation of variations than Reversion—is, that any such advances in development, and any such slight variations, are but the regain of what was previously lost by the varying species; and, being restricted, therefore, in amount, to the amount lost by such species, the amount preserved and accumulated by Natural Selection must necessarily be commensurately restricted.

Third: With respect to Darwin's assumption, that an occasional, marked variation may probably "arise once in the course of thousands of generations;" it is not intended to gainsay this point, but,

Fourth: It is intended to show that even though these

occasional, marked variations did arise under nature, and as many arose there as are known to arise under domestication, and even though Natural Selection were proven to be fully competent, in itself, to preserve and accumulate these variations; the accumulation of such variations, by means of Natural Selection, could not proceed to the extent necessary to evolve one species into another; because the presumption, before adverted to—arising from the very conditions under which, Darwin says, Natural Selection works,—arising from rudimentary, reduced and wholly suppressed organs which, Darwin admits, are so rife among all animals and plants—and arising from the absence of any other scientific explanation of the variations—is, that such occasional variations are due to Reversion; that, in consequence, they are limited to the number and kind which the given species once lost; and that their accumulation by Natural Selection, beyond the number and kind once lost, is impossible.

First: Now, with respect to the first point, Does the extinction of the weakest, and the selection of "the strongest and most vigorous" *prove* any, even the slightest advance in development?

As Darwin alleges Natural Selection to be the analogue of Man's Selection, it is well, first, to ascertain the conditions under which Man's Selection works; and, to see whether Man's Selection implies any advance in development.

The Selection of certain inviduals, under man's care, for breeding purposes, is generally held to induce the improvement of the animals.

Is it the Selection which causes such advance?

Manifestly, it is not. The advance in development is produced, independently of the Selection. Man's Selection does but preserve and accumulate the developments.

Selection either does but preserve those which progress the fastest; or, where some alone of the individuals improve, it does but preserve those which have improved; or, where none improve, but some degenerate, and some hold their own, it does but preserve those which hold their own; or, where all have degenerated, it does but preserve those which have degenerated the least.

Obviously, then, the fact, that those selected have increased in development, must first, either be assumed, or be proven; before any argument may be drawn from Selection, designed to prove any ratio of accumulation of slight successive increments of development.

Therefore, it is, that we contend that Darwin cannot justly prove the needful, slight advances in development, by means of Selection; for, that process never even implies advance in development, unless advance in development is first assumed, or proven, *aliunde!*

If, in any generation, the individuals, of a species, under nature, do but hold their own; or, if they degenerate, it is manifest, that Natural Selection, *per se*, cannot imply any advance in development. Advance in development must be established, independently, as a fact; or, inferred from the circumstance, that the conditions, to which the individuals of the given

species are subjected, are favorable; that the organisms have an abundance of food, a healthy climate and all the other requisites of a propitious *habitat;* and, that they suffer not from a ruinous competition. Even these circumstances, however, would but argue, that the individuals held their own.

If, however, the fact be; or, if the presence of unfavorable conditions imply; that all of the individuals, of such species, are degenerating, the mere Selection of those which are the least degenerate, cannot argue any advance in development. If, again, the fact be; or the nature of the conditions imply; that some of the individuals have degenerated, and that some do but hold their own, the mere selection of those, which do but hold their own, cannot argue advance in development.

Now, Darwin, represents the conditions, under nature, to be very unfavorable. In fact, it was absolutely incumbent upon him to picture them, as well nigh fearful, in order that they should work the extinction of those which prove the weakest. Yet, those individuals, the elect, which have been, similarly with the weakest, subjected to these conditions, he pretends, are advancing in development!

Let the reader fancy his emotion, were he the owner of live stock, and were his farmer to assure him that he "reckoned," that the stock were improving, because (*sic*) the conditions, to which all of the herd were subjected, had long been so hard and rigorous, that all of the weaker ones were being killed off; and, as the strongest and most vigorous (?) were the only individuals, of

the herd, which could endure, at all, the effects of the climate, of the rough treatment, of the insufficient food, and of the bitter competition prevailing to obtain the necessaries of life, the breed must eventually offer many prize animals; because, "the strongest and most vigorous," only, would survive, to produce offspring. Even if the reader cared, only to raise a few, from the herd, which might be capable of taking a prize, would not his fears be justly and reasonably provoked for these, by such a statement? and would not he be thankful, under the circumstances, if the result showed, that "the strongest and most vigorous" had but managed to hold their own? It would be absurd, in the absence of a special excuse, to fancy any farmer talking and arguing, in such a manner. Yet, such a farmer would display, to the full, as much intelligence and sense, as does Darwin, in propounding his theory of Natural Selection.

The problem of Selection resolves itself into the question: What are the conditions? do they imply development? or do they imply degeneration? or, do they imply any more than that the individuals hold their own?

Ask any farmer, of even inferior intelligence, if the mere Selection of the best animals, of a herd, will produce advance in development; and, he will, before answering, desire to know, under what conditions, favorable or adverse, the herd is placed. If the whole herd be degenerating, and if the elect are but those which are least degenerated, he will laugh at the idea of advance in development; and assure his questioner

that mere Selection, by itself, does not argue any advance in development. If, he were told, that it was not Man's agency which wrought the Selection; but that such Selection was effected through the extinction of the weaker animals, by means of unfavorable conditions to which all the animals were alike subjected, he would doubtless guffaw most vulgarly, at the idea of even the possibility of any advance being inferred from Selection so occasioned.

Advance in development is usually, or ordinarily, implied by Man's Selection; because, usually, or ordinarily, there is an advance in development, among the select of animals, under domestication, owing to the favorable conditions there generally prevailing. In extending the idea of Selection to animals and plants, under nature, Darwin has gratuitously carried, along with such idea, this implication of an advance in development,—an implication which arose, under domestication, from the favorable conditions under which the animals and plants are there placed. Before applying the idea of Selection, to animals and plants, under domestication, it was known, that, with them, there *was* advance in development; and, even if it were not known, as a fact, the favorable conditions, there generally prevailing, implied it. Before, however, Darwin could be justified, in carrying, to the state of nature, this implication, raised by the facts, and by the favorable conditions under domestication, it was necessary that he should adduce full warrant for such implication of advance under nature. Proof was needed, either, of the fact, or of favorable conditions.

But, he has, neither, the fact, nor the favorable conditions.

He has not the fact, required to warrant such an implication; for, *this very point of advance in development under nature, is what he is endeavoring to prove, by means of an argument from Natural Selection, into the premises of which argument, he has surreptitiously conveyed this very implication which issues forth, with such éclat, as his conclusion!* Advance in development, figures, both, in his assumption, and in his conclusion. What he inserts in his premises, he, with ease, extracts in the conclusion.

Neither, is he able to establish such an implication, by proof of favorable conditions, under nature; for, he shows that the very converse there obtains. *By the very terms of his argument, the conditions, under nature, to which, he says, all of the organisms, without exception, are subjected, are absolutely required to be adverse, and very unfavorable to development, in order to work the very Selection, which is designed to prove advance in development!* Insufficient food, and all the other elements of the Struggle for Existence, are required to operate upon all, in order to kill off the weaker; and such conditions obviously cannot establish an implication of advance in development, when their effect is death and extinction, to myriads of the numbers exposed to them. For; given, the effect of such conditions, upon the latter individuals, to be death and extinction; what will, presumptively, be the effect upon the development of those which Natural Selection preserves? Will not Natural Selection be doing all that

may reasonably be required of it, if it enable its select to hold their own?

Such implication is negatived, not only by the unfavorable conditions under nature, but by all of the facts which bear upon the problem. The many "rudimentary organs," which, he says Natural Selection has reduced to their present condition; from a perfectly developed state; and the many "long-lost characters," which, he says, lie latent in organisms, militate against his assumption.

The very order, in which he arrays his argument, exposes the above fallacies, and reveals still others.

1. The first proposition which he lays down, is, that there is an ever-recurring Struggle for Existence, among all animals and plants under nature, entailing the extinction of many such animals and plants; which Struggle for Existence, in the order of time, precedes the Selection, and is absolutely necessary to such Selection.

He avers, that all organisms, under nature, have had to struggle hard for their existence.

"More individuals are born, than can possibly survive. A grain in the balance will determine which individuals shall live, and which shall die" (p. 552, *Origin of Species*).

Even "the strongest and most vigorous" have had to enter into competition with their fellows, and with other species, for the means of existence; and have had to withstand, in each generation, the action of adverse climatic influences, of want of food, and of the other hard conditions which entailed the extinction of

their weaker brethren. An idea of the battle for life, which Darwin pictures, as the ordeal through which all organisms have to pass, may be derived from the extracts given below. The tale which the picture tells, it must be acknowledged, is not the happiest possible inducement to an argument, designed to prove advance in development—*net* advance, too. It is, however, the misfortune with Darwin, in his exposition of his theory of Evolution, that, at each stage, as he advances, he has been constrained to a choice between rival absurdities. Darwin's description of the Struggle for Existence, shows conclusively, that, so far from animals and plants, having advanced in development, the most that it has been possible for them to do, has been to hold their own; and, that, when they have not remained stationary (which, as the reader will see, is quite difficult of performance, in the face of such conditions), their movement has been in the direction of degeneration. It must be conceded, that the adverse conditions under nature, are sufficiently strongly portrayed, in the following quotations, to prompt an estimate, rather, of how much even "the strongest and most vigorous" have deteriorated, than of how much they have advanced in development.

In his *Origin of Species*, Darwin says:

"Nothing is easier than to admit, in words, the truth of the universal struggle for life, or more difficult,—at least I have found it so,—than constantly to bear this conclusion in mind. Yet, unless it be thoroughly ingrained in the mind, I am convinced that the whole economy of Nature, with every fact on distribution, rarity, abundance, extinction, and variation, will be

dimly seen, or quite misunderstood. We behold the face of Nature, bright with gladness; we often see superabundance of food; we do not see, or we forget, that the birds which are idly singing around us, mostly live on insects or seeds, and are thus continually destroying life; or, we forget how largely these songsters, or their eggs, or their nestlings, are destroyed by birds and beasts of prey; we do not always bear in mind that, though food may be now superabundant, it is not so at all seasons of each recurring year."

Again he says:

"Climate plays an important part in determining the average numbers of a species; and periodical seasons of extreme cold or drought, I believe to be the most effective of all checks. I estimated that the winter of 1854–55 destroyed four-fifths of the birds on my own grounds; and this is a tremendous destruction when we remember that ten per cent. is an extraordinarily severe mortality from epidemics with man. The action of the climate seems at first sight to be quite independent of the struggle for existence, but in so far as climate chiefly acts in reducing food, it brings on the most severe struggle between the individuals, whether of the same or of distinct species, which subsist on the same kind of food. Even when climate, for instance, extreme cold, acts directly, it will be the least vigorous, or those which have got least food, through the advancing winter, which will suffer most. When we travel from south to north, or from a damp region to a dry, we invariably see some species gradually getting rarer and rarer, and finally disappearing; and the change of climate being conspicuous, we are tempted to attribute the whole effect to its direct action. But, this is a very false view; we forget that each species, even where it most abounds, is constantly suffering enormous destruction at some period of its life, from

enemies or competitors for the same place or food; and if these enemies or competitors be in the least degree favored by any slight change of climate, they will increase in numbers, and as each area is already stocked with inhabitants, the other species will decrease. When we travel southwards and see a species decreasing in numbers, we may feel sure that the cause lies quite as much in other species being favored, as in this one being hurt. So it is, when we travel northward, but in a somewhat lesser degree, for the number of species of all kinds, and therefore of competitors, decreases northward; hence, in going northward, or in ascending a mountain, we far oftener meet with stunted forms, due to the *directly* injurious action of climate, than we do in proceeding southward, or descending a mountain. When we reach the Arctic regions, or snow-capped summits, or absolute deserts, the struggle for life is almost exclusively with the elements."

Again he says:

"Battle within battle must ever be recurring, with varying success; and yet, in the long run, the forces are so nicely balanced, that the face of Nature remains uniform, for long periods of time, though assuredly the merest trifle would often give the victory to one organic being over another. Nevertheless, so profound is our ignorance, and so high our presumption, that we marvel when we hear of the extinction of an organic being; and, as we do not see the cause, we invoke cataclysms to desolate the world, or invent laws on the duration of the forms of life."

Speaking of a forest, in order to exemplify the Struggle for Existence, he says:

"What a struggle between the several kinds of trees, must here have gone on during long centuries, each annually scattering its seeds, by the thousand;

what wars between insect and insect,—between insects, snails and other animals, with beasts and birds of prey,—all striving to increase, and all feeding on each other, or on the trees, or their seeds and seedlings, or on the other plants which first clothed the ground, and thus checked the growth of the trees!"

What is the obvious outcome of such a condition of affairs? Is it not, manifestly, degeneration?

But, the effect of this Struggle for Existence, is not left to presumption alone, strong as is that presumption. Darwin shows the actual effect of the action of this factor, in the many "rudimentary organs," which "plainly show that an early progenitor had the organ in a fully developed state; and this, in some instances, implies an enormous amount of modification in the descendants." He shows the actual effect of this factor, when he says, that "Rudimentary organs are so extremely common throughout nature, that scarcely a single species can be mentioned, which is free from such a blemish." He shows the actual effect of this factor, in the multitude of "long-lost characters," to which he so frequently refers. He shows the actual effect of this factor when he admits that, "Not but that it" (the Struggle for Existence) "may and will leave many creatures, with simple and unimproved structures, fitted for simpler conditions of life, and in some cases will even degrade and simplify the organization. * * "

Now, we have not moved beyond the first stage in the order, in which he arrays his argument, before we find that, at that stage,—in the very inducement to his

argument,—degeneration (which is the converse and refutation of the conclusion, at which his argument aims), is established, beyond question, by, both, an overwhelming presumption, arising from the very terms used in the inducement to such argument, and by facts conceded by Darwin, to be incident to the conditions under which works the main factor that he employs.

The reader doubtless fancies, that, assuredly, the very first care, with Darwin, will be to obviate,—or, at least to endeavor to obviate,—this strong and apparently insuperable objection to his argument. But, no; Darwin proceeds with his ratiocination,—or induction, for it is always well nigh impossible to determine how he reasons,—as serenely and complacently, as if he had essayed, exclusively, to prove the descent of a mouse from an elephant, instead of the descent of an elephant from a mouse.

By the methods with which he argues, the outcome may be, as of old, the evolution of a ridiculous, little mouse; but it will never be the evolution of any other organism.

2. His next proposition, in order, is that, in this Struggle for Existence, "the strongest and most vigorous" alone survive.

There is a fallacy, lying *perdu*, in these terms, "strongest and most vigorous." They beg the whole question; and they beg it, in the face of a state of facts, which wholly disprove the gratuitous assumption.

Viewed with reference to the circumstances of the fearful "battle for life," to which, Darwin says, all or-

ganisms have been subjected, the terms, "strongest and most vigorous," are, even in a grammatical sense, incorrect.

Viewed with reference to the same circumstances of the Struggle for Existence, and viewed with reference to the inference, intended to be drawn from the application of such terms, the terms "strongest and most vigorous," are wholly false, in the connection in which Darwin uses them.

"The strongest and most vigorous survive!" Let us define terms. Are these elect, which have survived, to be styled "strongest and most vigorous;" when, the sole idea possible to be gained, of the state of their strength, or of their weakness, is that which is to be gathered from the conditions, to which they, similarly with those which succumbed, have been subjected? and when such conditions are represented, by the very argument, to be adverse, and wholly unfavorable to strength or to development? According to the argument, the Struggle for Existence has acted upon those styled "the strongest and most vigorous," as well as upon those, yclept, the "weakest." Those, in which the conditions induced such impaired constitutions as were incompatible with prolonged existence, were, evidently, to be termed the weakest and most degenerate. What then, manifestly are the survivors correctly to be styled, which were alike subjected to such adverse conditions, and which owe their prolonged existence to a mere "grain in the balance?" What do even merely grammatical principles prescribe, that these should be called, which had also to fight the con-

ditions which proved too much for their weaker brethren? Should not they, in view of the unfavorable conditions so graphically described by Darwin, be styled, the least degenerate, or the least weakened?

In the use of terms of comparison, regard must be had to surrounding circumstances. If the surrounding circumstances of Natural Selection had conveyed the idea of strength, then, "strongest or most vigorous" would be proper. But, when the conditions of Natural Selection are confessedly so adverse, and when the effect of the operation of such conditions, is, obviously, to induce weakness and degeneration, terms of comparison, in harmony with such conditions, alone should be used. Darwin's use, therefore, of such terms as "strongest and most vigorous," is, in connection with the idea of such a fearful Struggle for Existence, clearly improper, irrespective of any argument which may follow. Usage, it is true, often countenances such a grammatical latitude, as the employment of the terms "strongest and most vigorous," where "the least weakened," in strictness, should be used; and, it would unquestionably be the very quintessence of pedantry, to cavil wantonly at such a slight departure from what, upon a rigid construction alone, is improper. But, Darwin has here availed himself of such latitude of expression, to hide a fallacy, fraught with the most momentous consequences; and, therefore, a correct use of terms is demanded. Had Darwin rigidly conformed to true principles of expression, he would have said: The weakest and most degenerate

succumb to the hard conditions which constitute the Struggle for Existence; and the least weak and the least degenerate, and those which manage to hold their own, survive. Had he so expressed himself, no implication of advance in development would have arisen, as it does arise, when, in the face of the converse implication, arising from the fact of the Struggle for Existence, he uses the terms "strongest and most vigorous," in the stead of the terms, least degenerate, or least weak.

When Darwin says, that, in each generation, "the strongest and most vigorous" survive, and that they alone continue the line of descent for the given species, the presumption, arising in the mind of his reader (and the presumption which Darwin evidently designed should arise), is, that there is, therefore, advance in development. This presumption, as has already been shown, does not necessarily attend the fact of the selection of "the strongest and most vigorous." This presumption legitimately arises, only from such selection, and from conditions favorable to an advance in development, combined. The place, where the presumption has been generally employed, has been under domestication. There, the two conditions of the presumption, prevail. There are, generally, under domestication, both selection, and favorable conditions which have been observed generally to induce an advance in development.

Under nature, there is selection, but there are not favorable conditions; for, to work the selection there, there needs must be unfavorable conditions! In drawing the

presumption, respecting animals under Man's care, especial note has been taken of the selection; the favorable conditions remaining understood. Darwin has carried the idea of Selection, to organisms under nature; and, availing himself of the circumstance, that the favorable conditions, have long been only tacitly understood, in drawing the presumption of advance in development, he has, in a field where favorable conditions do not obtain,—where unfavorable conditions confessedly prevail, aye, where the other condition of the presumption (namely, Selection) cannot obtain where favorable conditions exist,—illegitimately helped himself to the presumption of advance in development, which holds good, only where there are favorable conditions to imply such advance in development. Under domestication, "the stronger and more vigorous," of any one generation, are usually stronger and more vigorous (where selection is exercised) than the individuals of the preceding generation. Darwin, affects to believe, that all that is necessary, in order to prove advance under nature, is to show Selection; as that, generally, is all that seemingly needs to be done, under domestication. But, the implication, which attends the fact of Selection, under domestication, does not attend the same fact under nature; for, under domestication, there is an advance in development, which is implied by the favorable conditions under domestication: Whereas, the conditions under nature,—aye, the very conditions which, according to the argument needs must be very adverse, to work the Selection which is designed to prove the advance in development,—imply

the converse, viz., that there is not such advance in development, but, rather, a retrograde movement, in even the elect, or the "stronger and more vigorous."

There is another fallacy in Darwin's use of the terms, "stronger and more vigorous;" independently of the consideration that, in view of the circumstances, they are grammatically incorrect. The assertion, that the "stronger and more vigorous" survive, may (when the sometime-mentioned latitude of expression is allowed) be true, in one sense; but is false, when viewed with reference to the inference designed to be drawn. In Darwin's statement of the *fact* of the Selection under nature, he uses the terms "stronger and more vigorous," as if he intended them as terms of comparison with their contemporaries only. In the *inference* which he draws, however, he employs them,—not as terms of comparison only with those individuals which have succumbed,—but as terms of comparison with the individuals of a preceding generation. When his readers read his statement, that "the stronger and more vigorous" survive, they yield assent to the proposition. Yes (they reason), they (the elect) are stronger and more vigorous than the weak ones with constitutions so impaired as to cause death. But, when the readers are asked to accept Darwin's alleged inference therefrom (*i. e.*, of advance in development), they are assumed (by Darwin) to have yielded assent to something entirely different. They assented to the implication, that the elect were stronger and more vigorous than certain of their contemporaries; and, now, in the inference forced upon them, they are coolly assumed

to have assented to an implication, that the elect were stronger and more vigorous than their progenitors! Verily, is it, that, by "words, words," alone, Darwin passes "through the safe-gate into the temple of certainty." The touchstone to Darwin's fallacy, that Selection, *per se*, argues any advance in development,—the failure to apply which has led to all the confusion,—is the query: "Stronger and more vigorous? Compared with whom? Their contemporaries only? or their contemporaries and predecessors?"

In Paris, under the Commune, when famine and murder vied for the mastery, and in cities stricken with the plague, "the stronger and more vigorous" survived —But, "stronger and more vigorous," compared with whom? Manifestly; compared, not with individuals of the preceding generation, but with those only, placed in the same straits with themselves.

According to Darwin's argument (?), the more adverse and unfavorable the conditions of life are, the greater is the advance in development! because, as he contends, the harder the conditions of life, the more rigid and exclusive will be the Selection! Mephistopheles doubtless had in mind, this theory of Darwin, when, in his advice to the student, he counseled him to stick to "words," as a theory might well be built of "words."

That the conditions, under nature, imply a retrograde movement in those even which are preserved by Natural Selection; and, that, therefore, those conditions militate against Darwin's use of the terms "stronger and more vigorous" to denote those se-

lected, cannot well be questioned by any one who reads Darwin's statements respecting Natural Extinction and Natural Selection. According to Darwin, all, even the elect, are amenable to the Struggle for Existence. Numbers are born into the world at a rate, Darwin says, which, if not met by Natural Extinction, would soon cover the world with the progeny of a single pair. They all join in the battle for life; and, although thousands succumb, they have during even their short lives, helped to sharpen the competition which "the stronger and more vigorous" have to endure; and have thus lent their aid to induce the deterioration of those selected to continue the line of descent. All have to struggle for their existence, from the hour of their birth to the moment of their death: according to Darwin. Natural Extinction carries off —not those whose constitutions are merely impaired, or those which are merely degenerate in structure, for multitudes of these do actually survive and procreate others endowed with their defects—but those only, whose impaired constitutions, or whose defective structures, are absolutely incompatible with prolonged existence. The adverse conditions, which occasion Natural Selection, manifestly do more than kill off the weakest. They also cause a degeneration, both of those which have barely escaped extinction, and of "the stronger and more vigorous." The "stronger and more vigorous" may, in view of the competition for means of subsistence, to which Darwin pictures them as being subjected, count themselves very fortunate, if they merely manage to hold their own. Hold-

ing their own, implies no advance in development; and the adverse conditions, shown by Darwin, imply that any move made by the "stronger and more vigorous," was in the direction of degeneration. Does not Darwin's statement of the fearful battle for life, imply, that, though possibly "stronger and more vigorous," they are generally, less fit, less strong, and less vigorous than the preceding generation?

Natural Selection, at the best, is nothing but a struggle or a protest against degeneration. The retreat of a man, with his face, however, towards the foe, typifies Natural Selection and the Struggle for Existence; and any argument, designed to prove that the man was advancing upon his enemies, based upon the mere circumstance that his face was in the direction of advance, would be a perfect analogue of Darwin's argument from Natural Selection. The man's retrograde movement symbolizes the obvious effect of the adverse conditions under nature, which provoke the Struggle for Existence. The position of the man, confronting his foe while he retreats, symbolizes Natural Selection, or the survival of "the stronger and more vigorous." The mere survival of "the stronger and more vigorous" does not imply any advance in development. At the most, it can but imply a continuance, of those organisms, in the same state. Under the conditions of Natural Selection, and under the evidence which Darwin gives, of so many "rudimentary organs," and of so many "long-lost characters," the survival of "the stronger and more vigorous," proves only that the minimum of degeneration,

possible under the circumstances, obtains with these elect; or, in other words, that the less degenerate and the less injuriously modified individuals survive, whilst the more degenerate and the more injuriously modified individuals succumb. Given, the absence of all knowledge of the nature of the conditions of life under nature, the selection of "the stronger and more vigorous" implies merely, that these hold their own. Given, that knowledge of the conditions, which Darwin communicates to the reader, in his descriptions of the Struggle for Existence, the selection of "the stronger and more vigorous" implies that the "stronger and more vigorous" merely yield the least, to the effect of such adverse conditions.

Owing to the ingenious manner, in which Darwin has availed himself of the presumption of advance in development, from the fact of Selection, without formulating such presumption in set and explicit terms; it is open, to him, to deny that he has attempted to prove that increments of development must generally result from the selection of "the stronger and more vigorous." The main part of the strength with which his theory of Natural Selection is credited, however, is due to the belief, on the part of his readers, that the selection of "the stronger and more vigorous" does imply advance in development; and to the belief that Darwin so contends. Darwin, himself, unquestionably counts throughout, for support to his theory, upon this impression, so subtly conveyed by his handling of the question. It is true, that, with respect to the variations, which, he confesses, are gratuitously assumed

to arise, "in the course of thousands of generations," he explicitly disclaims any intention to maintain that Natural Selection causes, or in any way produces their appearance, and alleges that Natural Selection confines its operation, solely to the preservation and accumulation of those variations after they have arisen. But, this disclaimer he employs, solely in relation to these marked variations assumed to arise "in the course of thousands of generations;" and it ever seems, to the reader, not to apply to those very slight increments of development, which Darwin intimates, as strongly as he may, without explicit expression, to be the outcome of the mere selection of "the strongest and most vigorous." The idea which, wittingly or unwittingly, has been conveyed by Darwin, and which has caused Natural Selection to be so widely reputed as a most potent factor of development, is, that, although the pronounced, tangible variations assumed to arise "in the course of thousands of generations," are not, in any way, produced by Natural Selection, but are merely preserved and accumulated by that factor; yet that Natural Selection does produce very slight, scarcely appreciable increments of development, by means of the survival exclusively of "the stronger and more vigorous." Had Darwin's disclaimer, of any desire to maintain that Natural Selection induced the appearance of variations, been explicitly declared to cover these slight advances in development (which every one who reads Darwin's works, needs must conclude that he meant to represent as having been produced by the mere selection of "the stronger and more vig-

orous"), Natural Selection would never have enjoyed the reputation it has had, of being such a grand and important principle.

Second: Assuming, however, that the mere Selection, of "the stronger and more vigorous," does prove the appearance of slight increments of development, still his argument, that these may be so accumulated as to evolve higher species from ones lower in the scale, both begs the question at issue, and is negatived, in two several ways, by the very argument itself of Natural Selection. It begs the question, by tacitly assuming, that these slight increments of development are new developments, and that they may be accumulated indefinitely, or without any assignable limit; and, conversely, by assuming, that they are not the mere regain of developments, once lost by the given species, and that they are not capable, only of being accumulated to an extent, commensurate with the past degeneration of such species.

The argument itself of Natural Selection negatives this assumption,—viz., that these increments are new developments,—by postulating the necessary dependence, of Natural Selection, upon a hard Struggle for Existence which manifestly implies previous degeneration, in the organisms displaying the slight advances; and Natural Selection itself implies, that any such increments of development which may arise in "the stronger and more vigorous," are the mere regain, by means of the law of reversion, of what was before lost. For, the argument of Natural Selection absolutely requires, that the Struggle for Existence—which

manifestly is a process of degeneration—should, in the order of time, precede Natural Selection; which is assumed to be a process of growth or of development. So, by the very terms of Darwin's argument, the strong presumption arises, that the increments of development—assumed to be the outcome of the selection of "the stronger and more vigorous"—are but the mere regain of what was lost by the degeneration so forcibly implied by the Struggle for Existence which preceded the action of Natural Selection.

But, the fact, of such degeneration, is not left to implication alone. Darwin shows explicitly, in his detail of a multitude of "rudimentary organs," and of "long-lost characters," that such degeneration actually did precede the action of Natural Selection.

It was open to Darwin, also to contend, that the Struggle for Existence implied advances in development, upon the principle that increase of activity often induces increase of growth in an organ. But, assuming such increase of structure, this is equally an instance of begging the question at issue. The presumption is, that such increase is but the regain of what was once lost. Any argument, of indefinite development, based upon such assumed increase of structure, would beg the question, by assuming, that the increase was a new development, in the given species. Darwin speaks of ducks which, by reason of their *habitat* having been removed to the highlands, have rudimentary, webbed feet. Place these ducks in an environment, where they may paddle, *ad lib.*, in the water; then argue from the re-development of the web in their feet, that, given

such development within a year, these ducks may, within a million of years, develop into higher species and genera; and a perfect analogue will be had, of the argument from increase of structure following increased activity. The webbed feet are but the re-development, of what was once lost, by the species in question; and any argument, founded thereupon, designed to prove the possibility of indefinitely continued development, is manifestly a gross *petitio principii.*

Third: As we have seen, Darwin argues, that there must be slight advances in development, because, in each generation, Natural Selection picks out "the stronger and more vigorous" to continue the line of descent. Whatever semblance of strength is in this argument, we have shown to be due to the most transparent of fallacies. Conscious, probably, of the absurdity of such an argument, Darwin deemed it necessary to supplement this mode of getting the slight development, for Natural Selection to accumulate, with a gratuitous assumption.

He assumes, that there are pronounced variations which arise, under nature, seemingly in the same inexplicable and spontaneous manner in which he deems the improvements, under domestication, to present themselves. This is his assumption. His argument therefrom, runs to the effect; that, most probably the possession of such a variation gives to the individual possessing it, such an advantage in the struggle for existence, as to ensure its survival, and the transmission of such variation to its descendants; that such descendants, "in the course of thousands of genera-

tions," may develop another such variation; and, that, by the indefinitely continued accumulation of such variations, these individuals may develop into organisms as high as any in the scale of development.

Respecting his assumption, of the variations occurring "in the course of thousands of generations," he says:

"Can it be thought improbable (*sic*) seeing that variations useful to Man have undoubtedly occurred, that other variations useful, in some way, to each being, in the great and complex battle for life, should sometimes occur in the course of thousands (*sic*) of generations? If such variations do occur (*sic*) can we doubt (remembering that many more individuals are born than can possibly survive), that individuals having an advantage, however slight, over others, would have the best chance of surviving and procreating their kind?"

Now, this is honest, frank, and ingenuous. He does not here,—as he does when treating of the survival of the merely "stronger and more vigorous"—endeavor to *prove*, by fallacious argument, that there are advances in development. But, he *assumes* that there are such advances in development;—the only appearance of an argument, in this connection, being his appeal to the circumstance that it cannot be alleged that the probabilities are against his assumption, inasmuch as such things occur under domestication. The probabilities, however, do obtain, against his argument; for, the conditions of life are different, being favorable to development in the one place, and unfavorable in the other. Having assumed these variations, he then proceeds

in his endeavor to show, that Natural Selection may accumulate them, *ad infinitum.*

Exception to this assumption of variations occurring "in the course of thousands of generations," may be taken, only on the ground that it is gratuitous; and that (as with variations under domestication), he terms these variations "spontaneous," and gives no law by which their appearance is governed.

Fourth: Now, as to his theory, that Natural Selection may accumulate these assumed variations indefinitely: It begs the whole question; and begs it, too, in the face of a strong presumption, arising from the very requirements of the theory itself, and begs it, in the face of what Darwin has explicitly shown to be the actual effects of the operation of Natural Selection, the main factor of the theory.

The said presumption is the one, upon which we have already commented at length, namely, The presumption, of previous degeneration, arising from the unfavorable conditions under nature, which absolutely require to be unfavorable, upon Darwin's theory of Natural Selection, in order to bring about this very Selection.

The alleged, actual effects of the operation of Natural Selection, are, namely, the "rudimentary organs," and "long-lost characters," adduced, so frequently and abundantly, by Darwin himself.

Therefore, it is clear that Darwin's argument, from Natural Selection, is a *petitio principii.* Nay, more, the premises of such argument rebut its conclusion. For, the presumption, from Darwin's own argument,

and from Darwin's own facts, is, that the variations, which he gratuitously assumes to occur under nature, are but the mere regain of developments, lost by the respective species in which they occur.

Given, the variations which he asks; assuming, even, that as many variations occur under nature, as are known to occur under domestication, and they avail Darwin nothing. The presumption is, that the species, in so varying, are but retrieving past degeneration.

Concede the efficiency of Natural Selection, in preserving and accumulating such variations, and it aids Darwin as little to attain the result he is so solicitous to achieve; for, if such variations are but the regain of lost characters, and are limited to the number and kind of such lost characters, how may Natural Selection continue long to accumulate, when the variations, which it is to accumulate, needs must give out, when all the lost characters are regained?

There is, really, no limit to the *potential* efficiency of Natural Selection. If the conditions of its operation would but hold out, it could perform all the wonders which Darwin ascribes to it. But they do not hold out. No more characters can be regained, and then accumulated by Natural Selection, than were lost. Darwin has proceeded upon the false assumption, that the gratuitously assumed variations under nature, are new developments. But this assumption of new growth or development is more than false; it is exquisitely absurd, inasmuch as the very argument itself, in which it appears, implies that it is false!

The question of the efficiency of Natural Selection is wholly immaterial. There is little doubt that, if this factor were not so "cabined, cribbed, and confined," it would be fully equal to the task of evolving a dragon from a mosquito. Natural Selection may be so efficient, potentially, that its capacity,—where suffered to display itself,—might be shown to be almost infinite. But, when the efficiency of Natural Selection, in accumulating variations, organs, or features, is circumscribed by the fact, that the variations, organs, or features, possible to be so accumulated, are restricted, in number and kind, to the number and kind previously lost by the respective, varying species; all speculation, as to what Natural Selection might or could do, if only it had sufficient variations, organs, or features to accumulate, will advance the theory of development, not a hair's breadth.

Darwin fancies, that, in the fearful struggle for existence which he describes as being continually waged, the possession of one of these slight variations, which are assumed to "occur in the course of thousands of generations," will give its owner such an advantage over its competitors, as will ensure its being classed with "the strongest and most vigorous," and as will therefore occasion its survival, by which it will be enabled to procreate its kind, and perpetuate the said variation in its descendants. This process, of the preservation of a varying individual, is assumed to repeat itself again and again, at intervals of a thousand generations or so; and the consequent aggregation of such variations is alleged to represent the assumed

development of a lower into a higher species. But, unfortunately, the consistency of the beautiful and ingenious hypothesis, is marred, by the part thereof which prompts the reader to an estimate of the amount of degeneration wrought upon such a varying organism, by the fearful Struggle for Existence, in the interval, of the thousand generations, which preceded the mysterious appearance of such a variation. Given, the "Battle for Life" to have been continually waging, during such interval, as Darwin assumes it to have been; was the degeneration, effected during such period, greater or less, than the degree of subsequent development, represented by such occasional variation? and, is it likely, in view of the circumstances detailed, that such variation was *net* gain to the given species? are questions which obtrude themselves upon the reader, who is competent to discern, that subjective harmony, even, is wanting in Darwin's argument from Natural Selection.

This question, of *net* gain to the species is an eminently suggestive one. Fancy a person endeavoring to prove that a certain friend of his was growing rich, in trade; and doing it thus: He has a large stock of goods—Everybody seems to be in the same line of trade—Sharpest competition, between them, that you ever saw—There have been "panic times" ever since he started in the business, and the same lively competion—He has a large number of clerks and salesmen, whom he has to pay, whether there is business or not—He is under a heavy rent—The disadvantages, over which he triumphs, may be conceived, when I state, that only

once or twice in a month, does a customer stray along, to buy a dollar's worth of goods, and that the whole amount realized upon sales, during the year, by the whole trade, is only about twenty dollars—When such a customer makes his appearance, every one in the trade attempts to seize upon the poor man, and he stands the risk of being torn, limb from limb—My friend, however, is so bland, persistent, and persuasive that, during the whole time he has been in the business, he has secured every customer, despite all the exertions of his fellow-tradesmen, and borne him off triumphant—Such being the case, can you doubt that he, having such an advantage over the others (*sic*), has rapidly grown rich?

His friend is thus proven (?) to have grown rich,—not by any calculation of his profits and losses,—but by an argument, based solely upon the advantages he possesses, over his competitors! The inducement to the argument, represents the friend and his fellow-tradesmen, suffering, most severely, from dullness of the times, from severe mutual competition, from heavy, current expenses, and from adverse conditions of almost every kind. Yet, nothwithstanding the continual drain upon his friend's capital, our hypothetical friend lays stress, exclusively upon the circumstance, that once or twice, in a month or so, his friend alone, of all his guild, is able to secure a dollar's worth of sales; and he deduces the conclusion, that, because his friend is the most successful (or, to put it, as it should be, the least unfortunate) man in the business, the amount of his profits is to be estimated, simply and solely, by the

measure in which he is more fortunate (or, rather, less unfortunate) than his fellows. It is manifest, however, that such measure of fortune, accruing from the occasional dollar which he receives, is not *net* profit, but the mere return, or regain (and that, but in a small degree), of the capital stock which has been fast melting away.

The analogy, we presume, is clear to all. This case is a fair analogue of Darwin's argument from Natural Selection. There was, originally, a certain amount of organic capital, in each species under nature. Darwin, in picturing the operation of Natural Selection, necessarily shows adverse conditions, whose obvious effect is a drain upon that capital. (Such effect is not merely obviously implied; but is shown in Darwin's "rudimentary organs," in his "long-lost characters," and in the wide scope which he ascribes to Reversion.) A favorable modification is assumed to occur "sometimes during the course of thousands of generations." This is the analogue of the tradesman's monthly sale of a dollar's worth of goods. Now, says Darwin, this assumed, favorable modification is a step in the advance of the given species towards a higher development. But, he has ignored the vital question as to whether it is *net* profit to the species in which the variation arises. It is, evidently, but the mere return of what has been lost. There has been,—according to the very argument which is used,—previous, organic expense, or loss; and this variation is but a partial return of the organic capital before expended. Before it was possible for him fairly to found any argument upon the profit or improvement, accruing to any animal or plant,

he should have shown, that the organic capital, lost either a generation or two back, or thousands of generations back, had been all regained; and that the favorable variations assumed, are *net* profit, to the given species. This, it is impossible for him to do.

We intend to show, in this work, by Darwin's own organic profit and loss account, contained in the books, entered up by himself, that there is not a single instance of profit (*i. e.* variation or improvement) adduced by him, which is *net* profit; and, conversely, that every positive variation or improvement, which he presents, is but *gross* profit, or mere regain of organic capital, once lost by the given species. We have heretofore shown, only, that all of the variations are explicable upon this supposition, and inexplicable, scientifically, upon any other. We shall, however, demonstrate that they are but the regain of capital once lost, under nature. We shall demonstrate that each individual is ruined or impaired, in constitution and in fertility, in proportion as it falls short of the original, organic capital of its species. We shall show, that not a single individual has, by means of variation, ever made any *net* organic gain, relatively to the amount of organic capital with which its species once, originally started; but that, in proportion as it has retrieved what it once lost, is it normal in health, constitutional vigor, and fertility; and we shall point out the individuals, and the different species, which, either, have had but small losses under nature, or having had great losses, have, in a great measure, recovered them; and contrast their health, constitutional vigor and fertility, with the respective degrees,

of ruin, of those which still suffer under great losses of organic capital, incurred under nature; or, of those which, having lost but little under nature, have been greatly degenerated by Man's Selection operating solely for his benefit, instead of for the organisms' good. This we shall do, not by mere speculation; nor by the mere balancing of degrees of probability, but by the crucial tests, Crossing and Close-Interbreeding, which are scales, or Biometers, adjustable, respectively, degree for degree, to the several degrees of ruin, and to the several degrees of accruing (gross) profit, of all the individuals of every species.

CHAPTER VI.

The Several Processes of Formation of Varieties.

In the fourth Chapter, we alleged that there is but one, normal coördination of characters, in each species,—a coördination comprising all of the positive characters of the given species; and we asserted, and promised to prove, that the impaired coördination in individuals, consequent upon the struggle for existence under nature, is repaired and made perfect, in proportion to the regain of the long-lost characters of the species. The same principle was formulated, in the last chapter, wherein it was asserted that the regain of that portion of the organic capital, once lost by the respective species, is attended with physiological good.

Were reversion, under domestication, or the re-development of features once lost by an ancient progenitor, proportionately displayed under domestication, in all of the lost characters, the redemption of our promise, were a brief task. But, the characters suppressed, or reduced in the individuals, when taken from a state of nature, are not concurrently re-developed. Quite frequently, the re-development of a character, to the neglect of other characters, impairs the harmony and the coördination of the organization, to a greater degree, than existed before the animal or plant was

placed under domestication. The phenomena of divergence of character, or of disproportionate Reversion, whilst complicating the problem greatly, afford, however, proof stronger, and more conclusive, than would be available, were full and concurrent reversion, the unvarying feature, under domestication.

That physiological good, does, as a general rule attend the improvement of animals and plants under domestication, may be shown. Darwin says (p. 212, Vol. ii, *Animals and Plants, &c*):

"Domestication, as a general rule, increases the prolificness of animals and plants."

As we shall see, increase of prolificness, or of fertility, is the principal test of an improved, physiological state.

Instead of all the parts of the organization of an animal or plant being simultaneously and proportionately developed, under domestication, Man, when he has utility for his guide, preserves and accumulates those parts only, which he values, and which are useful to him, for some special purpose of his own. In species, where man's fancy, or amusement, comes into play, he develops but one of the varying parts, in each variety; sacrificing, and subordinating the other parts, in the same variety, to the end he has in view. In some species, Man looks to the improvement of one or two characters only, in the individuals. In other species, while he develops all of the characters, he does what is most injurious to the individual organisms; he suffers those characters to be developed, only, each in a different variety. Each individual of a species, Darwin, in

his chapters on Analogous variation, shows to be capable of developing all of the positive characters of its species. But, the way varieties are formed, and formed so distinct, is, by Man's selection repressing this capacity in every direction, or in every character, and suffering it to be exercised in only the one character which Man assigns as the peculiar character of the variety, in which the individual has been placed. Darwin says, as has been before quoted,

"That we may infer, that, when any part, or organ, is either greatly increased in size, or wholly suppressed, * * the coördinating power of the organization will continually tend to bring all the parts again into harmony with each other."

If this be the tendency of the coördinating power of the organization, which it unquestionably is, it is manifest, that the system of man's formation of varieties, under domestication,—namely, of increasing, to a great size, the peculiarity of each variety, and of suppressing, or reducing, the other parts in the same variety,—is in derogation of this power, which "tends to bring all of the parts again into harmony with each other." The object of this chapter, is to see how, and how far, man has violated the normal, mutual relation of the parts. After having shown the many ways, in which he has varied the normal relation of the parts of a species, we shall proceed to show that Darwin is wrong, when he fancies, that man may mould an organism into any form he pleases, and yet not injure the individuals in a physiological sense. In this connection, he says (Vol. ii, p. 425):

"It is difficult to overrate our ignorance of the use of various parts of the organization."

The principal use of the various parts, is to preserve the normal relation, or balance of the whole; and this relation or balance may not be varied, *ad lib.*, by man, without evil effects upon the physiology of the organism. Such evil effects we shall show to be registered, in each individual; and to be susceptible of being read, with perfect ease, by every fancier, breeder, horticulturist and agriculturist.

The principal reason, why proportionate re-development does not occur under domestication,—why all of the characters do not, in each or in any individual, return concurrently to the original, perfect type,—why all of the lost characters are not regained, in each individual,—is, not only because man does not desire to develop all of the characters in each individual, but because, also, the different individuals are subjected to different conditions of life, which favor the development of special characters, in advance of the development of others. Man avails himself of this circumstance, and pushes the development of the first character presenting itself (if it be a desirable character), to an extreme point. When an individual has one character in the ascendant, man seizes it, and makes it the peculiarity of a given variety, and suppresses the development of all the other characters. Other individuals, with another character in an exceptionally-advanced state of development, are made to constitute another varietal type; and, the further the exclusive development of the distinguishing mark of this type,

is carried, the more the individuals of this class, become disproportionately developed. Every deviation, among the individuals of a variety, "from the standard of excellence which the breeder has established in his own mind" (p. 237), is esteemed a degeneration; although such variation be of a positive character, and although it consist of an organ essentially necessary to secure the normal relation of the parts.

Thus, it is, generally, the case, that each variety possesses a character, which it is necessary that the other varieties should possess; and, each variety lacks all of the positive peculiarities, of the other varieties, which, for full physiological integrity, it is necessary that it should possess. In other words, the positive characters of a species, which it is essential should all be developed in each individual of that species, are, instead thereof, apportioned among different individuals, or different varieties. In other words, a multiplicity of divergent varieties in any species, necessarily implies the loss, in each variety, of the positive characters peculiar to the other varieties of the species. With many animals, absence of true proportion is occasioned, frequently, by blind conformity to certain standards, existing in the breeders' minds. Thus, when a breed acquires a reputation, or distinct character, all of its then existing points,—both those positive, and those negative, both, those parts, of intrinsic value, and those not,—are faithfully preserved; as if, the preservation intact, of the existing structure, were a *sine qua non* of its good quality, or of its purity of blood; and this occurs, even when some of its features

are shockingly out of proportion, and when some are wholly suppressed.

Darwin says (p. 16, *Origin of Species*):

"Domesticated races * * often differ in an extreme degree, in some one part, * * when compared with one another."

(Page 31, *Origin of Species*): "One of the most remarkable features in our domesticated races, is, that we see, in them, adaptation, not indeed to the animal's or plant's own good, but to man's use or fancy."

(Page 33, *Origin of Species*): Darwin quotes Youatt, approvingly, as saying, that man, by Selection, as "with the magician's wand, * * may summon into life, whatever form and mould he pleases."

Simply varying the relations of the given number of parts belonging to a species, is not developing; and it shall be shown that, when the parts are not of the one, true ratio, there is evil inevitably entailed.

(Page 33, *Origin of Species*): Darwin says, that the very distinct varieties, observable under domestication, are "produced by the accumulation in one direction, during successive generations, of differences."

For breeders, and fanciers, to work upon, there are, at the start, under domestication, a certain number of characters in each species. In addition thereto, there are a number of characters, which were lost by a past generation, and which arise under the favorable conditions of domestication. From these characters, Man has formed the varieties of each species under domestication, by the following processes:

1. By the retention, of the individuals of a species,

at several stages of reversion, accounting merely for differences of size;

2. By continuing the process, of degeneration, commenced under nature, and retaining the individuals of the given species, at each stage of such degeneration, also accounting merely for difference of size;

3. By the re-development of the long-lost characters of the species, of which not a vestige remained; but, with an apportionment, or distribution of them, among different varieties;

4. By the retention, of the individuals of several varieties, at each stage of the re-development of the lost characters allotted to their respective varieties, thus accounting for the sub-varieties of the third class;

5. By the re-development of the rudimentary organs of the species, and their apportionment among different varieties;

6. By the retention of the individuals of several varieties, at each stage of the development of the rudimentary organs allotted to their respective varieties, thus accounting for the sub-varieties of the fifth class;

7. By the extreme, and exclusive re-development (or selection), of one part only, in each variety, among those parts which have been only partially reduced, under nature;

8. By the retention, of the individuals of several varieties, at each stage of the re-development of those parts, only partially reduced under nature; thus accounting for the sub-varieties of the seventh class;

9. By a process of degeneration, by which in several

varieties under domestication, Man effects the reduction or suppression of characters, which were not reduced or suppressed under nature;

10. By the retention of the individuals, of several varieties, at each stage of such degeneration; thus accounting for the sub-varieties of the ninth class;

11. By the re-development of one only of the characters which have been lost, suppressed or reduced under nature;

12. By the retention of the individuals of several varieties, at each stage of the re-development of this one character which was lost, suppressed or reduced under nature, thus accounting for sub-varieties of the eleventh class.

Take a hundred rubber balls, of like size and character, and compress them all to half their size; then, in ten, or a dozen of the balls, relax the pressure, in a different part, in each ball; then, in others of the balls, relax, but slightly, the pressure, in each ball, in a part corresponding to the part with its pressure relaxed, in one of the balls of the first class; then, in other balls, relax the pressure all around, but in a different degree, in each ball; then, in other balls, instead of relaxing the pressure, much increase the pressure, upon a different part, in each ball; then, in other balls, instead of greatly increasing the pressure, in a different part, in each ball, increase the pressure, but increase it somewhat less, in a descending degree, in a part in each ball, corresponding to the same part in each of the balls of the preceding class; then, in other balls, increase the pressure, all around, in a degree varying with each ball,

instead of increasing it in parts only; then, in one ball, relax the pressure fully, in one part only; and then in other balls, relax the pressure in the same just-mentioned part, but relax it less and less, in a descending degree, in the several, remaining balls.

Having done this, conformably to direction, you will have varieties, of the, originally, one kind of ball, exactly analogous to varieties of a species under domestication. The compression, of the ball, represents degeneration; the elasticity, displayed upon relaxation of the pressure, corresponds to reversion. The disproportionate compression, and disproportionate relaxation, are respectively analogous to disproportionate Reversion, and to disproportionate degeneration, in organisms. The balls, in their original, normal state of expansion, represent the original, normal type of a species. As the restraint, upon the several balls, constraining them to a shape, not in harmony with the natural properties of their matter, is abnormal; so, the disproportionate development of varieties, is abnormal, as the retention, of their parts, at any stage short of full, complete reversion, is in derogation of the one, true ratio of their development. In the case of an organism, there is a crucial test, demonstrating most positively, that any constraint to a shape, short of the full development of all the positive features of the species, is injurious to physiological integrity.

The compression, of the ball, to half its size, does not exactly represent the degeneration in species, under nature. For the compression, above mentioned, is im-

pliedly equal, all around; whereas, degeneration is not equally effective, upon all the characters of a species. It reduces some very slightly; much reduces others; and wholly suppresses still others; according to the conditions of life, to which the several races, under nature, were subjected.

The several processes, of formation of varieties under domestication, are nearly all exemplified in the case of the Pigeon. This species, under domestication, is pre-eminently conspicuous among those whose varieties are greatly divergent in character.

"In practice," says Darwin (p. 125, *Origin of Species*), "a fancier is, for instance, struck by a Pigeon having a slightly shorter beak; another fancier is struck by a Pigeon having a rather larger beak; and on the acknowledged principle that 'fanciers do not and will not admire a medium standard, but like extremes,' they both go on choosing and breeding from birds with longer and longer beaks, or with shorter and shorter beaks."

"Compare," says he (p. 22, *Origin of Species*), "the English Carrier, and the shortfaced tumbler, and see the wonderful difference, in their beaks, entailing corresponding differences in their skulls."

"The Carrier is also remarkable" (p. 22, *Origin of Species*), "from the wonderful development about the head"—from "greatly elongated eyelids, very large external orifices to the nostrils, and a wide gape of mouth. The shortfaced tumbler has a beak, in outline, like that of a finch. * * The Runt is a bird of great size, with long massive beak and large feet; some of the sub-breeds of Runts have very long necks, others very long wings and tails, others simply short tails. The Barb is allied to the Carrier, but in-

stead of a very long beak, has a very short and very broad one. The Pouter has a much elongated body, wings, and legs, and an enormously developed crop. * * The Turbit has a very short and conical beak, with a line of reversed feathers down the breast, and it has the habit of continually expanding, slightly, the upper part of the œsophagus. The Jacobin has the feathers so much reversed along the back of the neck, that they form a hood, and it has proportionally to its size, much elongated wing and tail feathers. The Trumpeter and Laugher, as their names express, utter a very different coo, from the other breeds. The Fantail has thirty or even forty tail feathers, instead of twelve or fourteen, the normal number in all members of the great pigeon family; and these feathers are kept expanded, and are carried so erect, that in good birds, the head and tail touch; the oil gland is quite aborted."

A certain number of characters belong to the species, Pigeon. Those characters, which were, under nature, lost, and which are re-developed, under domestication, are distributed among different varieties and these characters, and the others, simply have their proportions, and their number, varied in the different varieties. In some varieties, some of these characters are wholly suppressed, or greatly reduced. All of the positive characters should be developed, fully and proportionately, in each individual. Each variety, obviously, then, falls short of the true type, viz., the sum of all the features. It is our task to show, that, inasmuch as each variety so falls short, evil is entailed upon it. This is done in the succeeding chapter.

(Page 262, Vol. i.) The fancier, says Darwin:

"Endeavors to exaggerate every peculiarity in his

breeds. A great authority says, 'Fanciers do not, and will not admire, a medium standard, that is, half and half, which is neither here nor there, but admire extremes.'"

"Domesticated races differ much, in some one organ, from the other races of the same species," * * though "the remaining parts of the organization will always be found in some degree different" (p. 150, *Origin of Species*).

Varieties, under domestication, "show adaptation to his (man's) wants and pleasure" (p. 14, Vol. i, *Animals and Plants, &c*).

"Domesticated races of animals, and cultivated races of plants, often exhibit an abnormal character, as compared with natural species; for, they have been modified, not for their own benefit, but for that of man" (p. 14, Vol. i).

Each individual Pigeon varies a little, in several ways, from even the others of the same variety, or sub-variety. Each differs, slightly, from the others of the same variety, and, greatly, from others of the other varieties, in the length, size, or number, of the wing-feathers; in the length, size, or number of the tail feathers; in the length, number, or size of the primary wing-feathers; in the number, length, or breadth of the ribs; in the size, and form of the body; in the number, and size of the scutellæ; in the size of the eye, and eyelids; in the size, length, and thickness of the feet and legs; in the length, and size, and breadth of the tongue and beak; in the size, and shape of the lower jaw; in the amount of wattle; in the heaviness of the coating of feathers; in the size,

and shape of the sternum, and of the scapula; and in every detail of the internal organs, of the skéleton, and of external adornment.

The mode, in which Man gets such distinct varieties, is by refusing to re-develop all of the characters, concurrently; and, by pushing the re-development of one, two, or but a few characters only, in any one variety.

Under the heading of "Tendency in Man to carry the practice of Selection to an extreme point" (p. 290, Vol. ii), Darwin says:

"It is an important principle that, in the process of selection, man almost invariably wishes to go to an extreme point (!) Thus, in useful qualities, there is no limit to his desire to breed certain horses and dogs as fleet as possible, and others as strong as possible; certain kinds of sheep, for extreme fineness, and others, for extreme length of wool; and he wishes to produce fruit, grain, tubers, and other useful parts of plants, as large and excellent as possible. With animals, bred for amusement, the same principle is even more powerful; for fashion, as we see even in our dress, always runs to extremes (!) This view has been expressly admitted by fanciers. Instances were given in the chapter on the Pigeon, but here is another: Mr. Eaton, after describing a comparatively new variety, namely, the Archangel, remarks, 'What fanciers intend doing with this bird, I am at a loss to know, whether they intend to breed it down to the Tumbler's head and beak, or carry it out to the Carrier's head and beak; leaving it as they found it, is not progressing.' Ferguson, speaking of Fowls, says, 'their peculiarities, whatever they may be, must necessarily be fully developed; a little peculiarity forms naught but ugliness, seeing it violates the existing laws of symmetry.' So, Mr. Brent, in discovering the merits of the sub-varie-

ties of the Belgian canary-bird, remarks, 'Fanciers always go to extremes; they do not admire indefinite properties.'"

He continues:

"This principle, which necessarily leads to divergence of character, explains the present state of various domesticated races. We can thus see, how it is that race-horses and dray-horses; greyhounds and mastiffs; which are opposed to each other in every character, —how varieties so distinct as Cochin-China fowls, and bantams; or Carrier Pigeons with very long beaks, and Tumblers with excessively short beaks; have been derived from the same stock. As each breed is slowly improved, the inferior varieties are first neglected, and finally lost. * * * Selection, whether methodical or unconscious, always tending toward an extreme point, together with the neglect, and slow extinction, of the intermediate and less valued forms, is the key which unlocks the mystery how man has produced such wonderful results * * * Continued divergence of character depends on, and is, indeed, a clear proof, as previously remarked, of the same parts continuing to vary in the same direction."

Instead of the pressure of degeneration being relieved in every part, in every individual, it is relieved, and reversion allowed to operate, solely in one part, or in a few parts, in each variety of the species. With the Pigeon, and with some other animals, all, or almost all of the characters of the species are regained; but they are suffered to be developed, not in each individual, or variety, but in different individuals or varieties. Then, many characters are reduced or suppressed, either directly by man, or owing to disuse. This disuse would not reduce the characters, were a reasonable

degree of selection, or of care, exercised by man. But, the reduction, or suppression, is thus suffered by man, because:

"Man," as Darwin says (p. 492, Vol. ii), "does not regard modifications in the more important organs * * * as long as they are compatible with health and life. What does the breeder care about slight changes in the molar teeth of his pigs, or for an additional molar tooth in the Dog; or for any change in the intestinal canal or other internal organ?" (Darwin does not say this invidiously, but approvingly). "The breeder cares for the flesh of his cattle, being well marbled with fat, and for an accumulation of fat, within the abdomen of his sheep, and this he has effected. What would the floriculturist care for any change in the structure of the ovarium, or of the ovules? * * * When he has produced any modification in an important part, it has generally been unintentionally, in correlation with some other part, as when he has given ridges and protuberances to the skulls of fowls by attending to the form of the comb."

Every character, which goes to make up any species, even the hair, feathers, hoofs, horns, teeth, tail, and ears is, by man, in some variety, exalted into undue prominence, or wholly, or partially suppressed; and thus a line of divergence from the other varieties of the given species, is thereby established. As Darwin says, If the fancier:

"Simply" (p. 506, Vol. ii) "admired, for instance, short-beaked, more than long-beaked birds, he would, when he had to reduce the number (of birds) generally kill the latter; and there can be no doubt that he would thus, in course of time, sensibly modify his stock."

A priori, it is not likely that nature suffers tamely this moulding, of a species, into any form which the utility, fancy, fashion, or caprice of man may dictate. There is a penalty visited upon each individual organism, commensurate with the degree of its departure from the sum of all the positive features of its species. The most outrageous liberties are taken with animal and plant forms; and, when the penalty presents itself in the shape of the evil effects of close-interbreeding, man, blind as a mole, can not discern the relation between these evil effects, and the disproportionate development which he has occasioned; but, needs must relegate the phenomena to his favorite category of the inexplicable; or, what is more asinine, he lumps all of the degrees of such effects together, and dubs them a "great law of nature!"

Among all the animals, under domestication, which have been degenerated, in character, by man, the pig is pre-eminently conspicuous. The more improved (?) the pig becomes, the more are its legs reduced. In the "best bred" pigs, the legs are so small as to be absolutely incompatible with locomotion, and they are incompetent to the very support of the animal. When it is required to remove such individuals, from place to place, it is necessary to carry them. It is, also, often as much as the existence of the individual is worth, to stand it upon its legs. The snout is likewise reduced; being, sometimes, no longer than the nose of a human individual. The tusks are well nigh suppressed; the front of its head is rendered short and concave. Its coat of bristles is suppressed. Its hair is much re-

duced. Its tail is infinitesimal in character; and the whole plan of the organization of the animal, seems to have been resolved into a mere barrel of fat. Darwin, in an ecstacy of admiration, at the signal triumph achieved, in these animals, by means of selection, terms them, "wonderfully improved." He says (p. 283, Vol. ii):

"Our wonderfully improved pigs could never have been formed, if they had been forced to search for their own food."

He says (p. 360, Vol. ii):

"Nathusius has shown, that, with the improved races of the pig, the shortened legs and snout, the form of the auricular condyles, of the occiput, and the position of the jaws, with the upper canine teeth projecting in a most anomalous manner in front of the lower canines, may be attributed to these parts not having been fully exercised. For, the highly cultivated races do not travel in search of food, nor root up the ground with their ringed muzzles."

"Again," he says (236, Vol. ii), "hear what an excellent judge of pigs, says: 'The legs should be no longer than just to prevent the animal's belly from trailing on the ground. The leg is the least profitable (!) portion of the hog, and we therefore require no more of it than is absolutely necessary for the support of the rest.' Let any one compare the wild boar with any improved breed, and he will see how effectually the legs have been shortened."

With horses, sheep, and cows, all of the characters of the respective species, are generally re-developed, in each variety; although in all of the varieties, the perfect proportion of the characters is, in a greater or less degree, absent.

With Plants, there is a great reduction and suppression of many characters. Under domestication, the floriculturist and agriculturist aim at the exclusive development of those parts which they value. Other characters of the species, are, either, left greatly reduced, are suffered to become wholly suppressed, or are systematically suppressed by man.

Darwin says (p. 509, Vol. ii):

"The best proof of what selection has effected, is, perhaps, afforded by the fact that, whatever part or quality, in any animal, and more especially, in any plant, is most valued by man, that part, or quality differs most in the several races. This result is well seen, by comparing the amount of difference between the fruits produced by the varieties of the same fruit tree; between the flowers of the varieties in one flower garden; between the seeds, roots, or leaves of our culinary and agricultural plants, in comparison with the other, and not valued, parts of the same plants."

Thus, if it is the fruit which is the desired feature, the plant will have that character so developed as to approximate perfection; whilst the flowers (including the petals, stamens, pistils, ovaries, ovules) and the leaves, the seed, the roots, the bark, the chemical elements, and the many other characters, will not only be neglected, but will be greatly reduced or suppressed; entailing thus, a development of the most disproportionate kind. With different plants of the same species, and even of the same variety, the neglected parts will vary, to some extent, in the degree of their development, owing to the varying conditions of life to which they are subjected; for, as Darwin says

(p. 304, Vol. ii), in speaking of the action of the conditions:

"Even the seeds, nurtured in the same capsule, are not subjected to absolutely uniform conditions, as they draw their nourishment from different points."

And again (p. 337, Vol. ii):

"Slight variations of many kinds * * * are retained as long as plants are grown in certain soils, of which Sageret gives, from his own experience, some instances."

These conditions, entailing slight changes, or slight advances in re-development, in the neglected parts, it may be well carefully to note; as they resolve the puzzling (to Darwin) phenomena of the Self-Impotence, and of the Crossing of plants.

Darwin says:

"The Relative position of flowers, with respect to the axis, and of seeds in the capsules," has some effect, in "inducing variability."

"With cultivated plants," he says, "it is far from rare, to find the petals, stamens, and pistils represented by rudiments."

Again, he says:

"The chemical qualities, odors, and tissues of plants are often modified by a change which seems to us slight. The Hemlock is said not to yield conicine, in Scotland. The root of the Aconitum *napellus* becomes innocuous, in frigid countries. The medicinal properties of the Digitalis are easily affected," &c., &c.

"With all improved Plants, * * they (floriculturists and agriculturists) examine the seedlings, and destroy those which depart from the proper type."

By this "proper type," is meant, a type in which the valued character of the individuals is improved, in a special way, and in which the parts not valued are degenerated in a particular way. It has required a great deal of care, and of selection, to fix the individuals of a variety, to a certain persistency of type. All of the characters evince an inclination to improve, *i. e.*, to revert; and, if this disposition is not kept down by vigorous weeding out of the "sports," as they are called, the individuals might, it is true, improve in those of their characters which are little developed; but that is not what the agriculturist, or horticulturist, wants. He desires to keep the variety uniform, so as to make it recognizable; and he effects this, by requiring the individuals of the variety, to adhere strictly to the standard he has formed. Man is jealous, frequently, even of an improvement, in the part he values; fearing lest he may not be able to fix the additional improvement, and make a variety; and, apprehensive that the plant may take upon itself to improve, also, in the other characters which he does not desire to have developed. Thus, if a "Bullock's heart" variety of the Cabbage, should present individuals, with an improvement obviously superior to the "Bullock's heart" leaf, those individuals would be remorselessly destroyed; for, improvement is not so much an object, as a class of individuals which will perpetuate their exact kind. Again, if grain be, for instance, slightly cylindrical in character, the individual grains, adhering rigidly to the prescribed type, will be valued, and alone preserved. Those departing

from the regular shape, or form, will be mercilessly proscribed; and, if the leaves, or other portions of the plant (the flowers, for instance), should attempt to improve, and to revert to the original type, subsisting before the degeneration, under nature, occurred; the agriculturist would be almost transfixed with horror, at such audacity. He adheres most religiously, to the belief that plants were made for his use; but the trouble is, that he, on the whole, defeats such use, by the manner in which he uses the bounty vouchsafed him.

Darwin says (p. 242, Vol. ii):

"The finest shades of difference, in wheat, have been discriminated, and selected with * * * much care."

The seeds only, in this species, are attended to. The leaves, flowers, &c., are all disproportionately developed. In fact, the further the exclusive improvement of the seed is carried, the more the true, normal relation of the parts, is violated. Darwin may well assert that "Sterility is the bane of horticulture," when all plants are cultivated upon a vicious system, entailing a most abnormal coördination of the parts of the species."

"Compare," says Darwin (p. 34, *Origin of Species*), "the diversity of Flowers, in the different varieties of the same species, in the flower-garden; the diversity of leaves, pods, or tubers, or whatever part is valued, in comparison with the flowers of the same varieties; and the diversity of the fruit of the same species in the orchard, in comparison with the leaves and flowers of the same set of varieties. See how different the leaves of the Cabbage are, and how extremely alike the

flowers; how much the fruit of the different kinds of gooseberries differ in size, color, and hairiness; and yet, the flowers present very slight differences. It is not that the varieties which differ largely, in some one point, do not differ at all in other points. * * * The laws of correlation of growth, the importance of which should not be overlooked, will ensure some differences, but the leaves, the flowers, or the fruit will produce races differing from each other, chiefly in these characters."

(It is these slight differences which, when united in mongrel offspring, effect the good which is occasioned by Crossing.)

The above cases represent the formation of varieties, by the development of one character only, of the species; and, by the retention of such character, at each stage of reversion. Each part, itself, is composed of several characters; and the different development of these characters, constitute varieties formed of the various developments of the one part. Thus, the leaves in different varieties of a species, may be of many different sizes, and of many different shapes (the same being modifications of the one normal shape), or, they may be more or less fleshy, and variously reticulated; or, they may be of several degrees of smoothness, or of several degrees of hairiness. The stems also may be variedly herbaceous, or variedly woody. The branches also may be more or less drooping, or more or less erect. In the flowers of each, or of several varieties, the stamens, pistils, calyx, corolla, anthers, ovules, ovaries, seed vessels, &c., may be of a different ratio with each other; or, some of these characters may even

be greatly reduced or wholly suppressed, represented by mere rudiments, or having not a vestige left. The capacity for reversion, in the parts not valued, is not encouraged, but, rather, suppressed, by every possible means.

"No one supposes," says Darwin (p. 48, *Origin of Species*), "that all the individuals of the same species, are cast in the same actual mould."

No one supposes that they are actually cast in the same mould; but, he who would understand the developments, arising under domestication, must hold that there is but one, *normal* mould for all the individuals of the same species, and that all of the varieties and races, under domestication, and under nature, are but various modifications of such original, true mould. All of the individuals of a species, are, originally, from the same mould. The mould, however, has been bent and distorted (by the adverse conditions of nature, and by man's misguided policy of selection), into every conceivable, diminished shape, and size. Those individuals only, which answer, in their structure, to the true mould of their species, are physiologically perfect. The true, normal mould is capable of covering all the positive differences of the varieties, and of the individuals of the same species. Given, the modification which, in any individual, the true mould of its species has undergone; and, the evil effects which constitute the penalty for such departure from such mould, will be observed to be in proportion. In proportion also, as the individuals return to the size, and shape of the original mould, will the evil, attendant

upon their modification of such mould, abate. It is evident, upon Darwin's own showing of the manner in which varieties of a species are formed, that each variety, when not distinguished from the others of the same species, merely by a negative character, has in it an element, which, if joined to another variety, would measurably advance the development, of such other variety, towards the original type or mould of the given species; and, that the combination of all the positive characters of many and widely distinct varieties of a species, in a single, or in each, individual, would realize the true mould, which is the sum of all the positive developments, possible in such species.

CHAPTER VII.

EVILS CAUSED BY A DEPARTURE FROM THE ORIGINAL TYPE OF A SPECIES; AND GOOD OCCASIONED BY A RETURN TO SUCH ORIGINAL TYPE: OR, CROSSING AND CLOSE-INTERBREEDING.

The principle of Reversion implies, that all the positive characters, of any given species, were originally, fully and proportionately developed, in each member of such species, and that such type alone is perfect, physiologically, as well as anatomically. Hence, it follows, that any modification of such type, must be injurious. It also follows, that the physiological state, of individuals, previous to their developing variations under domestication, should be a defective one, owing to the then absence or reduction, in them, of the characters, which they subsequently develop, and which are assumed to be essentially necessary to their physiological as well as structural integrity. It equally follows that, in proportion as such individuals regain these lost or reduced characters, should there be an abatement of the physiological evil occasioned by such loss or reduction; and it follows that, when all the positive variation possible for an individual of a given species, has been effected, there should exist a perfect, physiological condition in such individual.

To this, it may be answered, that such results are

obvious, theoretically; but, in default of positive proof thereof, it is all mere speculation. At the same time, it will be admitted that, if such required proof is adduced, the principle of one, normal type, to each species, and the principle that all positive variations are but the regain of lost or reduced characters, are demonstratively proven.

Such proof is available. The phenomena of Crossing, and of Close-Interbreeding, conclusively, aye, demonstratively, show, that an organism is vitiated by the reduction, suppression, or absence of any character or characters of its species. They show, that any ratio, between the characters of which an individual is composed, other than that ratio which subsists, when all of the positive features of the species are fully and proportionately developed, impairs the normal coördination of the parts. They show, there can be perfect coördination of parts in an individual, only when all the positive characters of its species are present and fully developed. They show that, in each species, all of the positive features, which it is possible for such species to develop, are wonderfully united, and have such delicate and intimate relations, that it is impossible to vary the proportions of such parts, without detriment to the organism, as a whole. They show, that such reciprocal dependence of all the characters, of a species, on each other, precludes the possibility of any organism being modified in any part, without entailing a breach of the laws of organization. They show, that the laws, of the whole organism, fail to operate fully, perfectly, or normally, when any of

the characters, of its species, is modified or absent. They show, that the further that degeneration, under nature, or that degeneration under domestication, has been carried, the more is the physiological integrity of the individuals, in question, impaired, on account of the loss, in such individuals, of characters of their respective species, or on account of the establishment of an abnormal ratio of the characters of their respective species. They show, that the further that positive Reversion is carried, or the more that characters are regained, and the nearer the original, perfect type of the given species, is approximated, the greater is the repair of this lost, physiological integrity. They show, that, only when reversion has been fully effected,—when all of the lost characters, of the respective species, have been regained,—and when the sum of all the positive features, of the given species, is realized in the individual, can there be full, physiological perfection.

The state of the individuals which vary, is shown to be a deficient, physiological condition, previous to their development of positive variations. That this is due to their then, deficient, structural condition, is attested by the circumstance that in proportion as they return to their full structural integrity,—that is, in proportion as they vary positively, or re-develop the characters assumed to have been originally lost,—do the physiological evils abate, and cease altogether when the full amount of positive variation possible for that species, has been effected. The connection of the evil effects with the deficient, structural condition of the indi-

viduals, is also proven by the fact, that, if the variation under domestication be of a negative character,—that is, if any character be reduced or suppressed,—the evils are observed to be proportionally augmented.

As then, the loss or reduction of any character entails physiological evil, the deficient, physiological condition of individuals, previous to their development of positive variations under domestication, proves that such individuals have had characters lost or reduced, under Nature; and, as the development of positive variations under domestication, abates the physiological evils (when such variations are proportionately developed), it follows that such variations are but the regain of those lost or reduced characters.

That evil is caused by a departure from the perfect type of the species, is shown by the phenomena of close-interbreeding. That good is occasioned,—or, rather, that the evils of a departure from the perfect type, are retrieved,—by a return to such normal type of the given species, is shown by the phenomena of Crossing.

Darwin asserts, reiterates again and again, and seemingly never tires of adducing facts to show, that good results from crossing distinct varieties of the same species, and that evil follows from interbreeding individuals of the same variety. Why these effects should flow, he does not know. But, such results, while confessedly wholly inexplicable upon Darwin's hypothesis, are, *a priori*, to be expected upon the theory of Reversion.

By crossing, each parent variety supplies, in the

mongrel offspring, a character or characters which the other parent variety lacks. The offspring of a cross, then, possesses two characters, at least, where either of its parents possessed one; and, thereby, either a full, or a measurable return to the original, perfect type, comprising all of the characters of the species, is effected. If a return to the sum of all the characters of the species, should result in physiological good, then a cross does but fulfill the requirements of the theory of Reversion, when the effects of a cross are (what Darwin has established, as unexplained facts merely), viz., increased fertility, and increased constitutional vigor.

If, on the other hand, an individual, wanting in any character, or lacking the full development of any character of its species, is, upon the theory of Reversion, to be esteemed physiologically defective, inasmuch as it falls short of the full, possible development of its species; then, it is to be expected that, when such individual is interbred with another, similarly defective, the evil entailed by such incomplete, or disproportionate development, will, in the offspring, be intensified, and become more manifest. As a fact, such is the case.

The evil effects of Close-Interbreeding, Darwin confesses, are wholly inexplicable upon any theory that he can devise. Yet, the theory of Reversion gives them a rational, full and conclusive explanation.

Not only are these results of crossing, and of close-interbreeding, wholly unintelligible to Darwin, but he shows, that there is a graduated scale of such results,

both in crossing and in close-interbreeding; and, these almost infinite variations in quantity of effect, he is alike at a loss to explain.

Now, the reader will see that, if it can be shown that, in Close-Interbreeding, such graduated scale of effects, ranges from the maximum, in those individuals most degenerated or most disproportionately developed, down to zero, in those individuals with all the characters of their respective species fully and proportionately developed, the theory, that there can be but one, perfect form, for each species, and that any modification of such form is deleterious, will be conclusively proven.

If, conversely, it can be shown, that the graduated scale, of good effects, in Crossing, ranges from the maximum, in those individuals which have mutually much to contribute to the offspring, which their mates respectively lack, down to zero in those individuals which cannot mutually contribute to the offspring, a character or characters which their mates respectively lack, such theory, of a perfect, normally immutable type, for each species, will be proven to demonstration.

The phenomena of Crossing, and of Close-Interbreeding, not only prove the theory of Reversion, but they directly disprove Darwinism. They not only tell a tale, the converse of that which Darwin would have his disciples to believe; but they are grossly and irreconcilably at variance with his theory. They show, demonstratively, that varieties are not "incipient species," and that varieties may not, by any possibility, diverge into distinct species. They show, demon-

stratively, that the divergence of character, by which he affects to believe, varieties are evolved into distinct species, is not normally possible; for, they show, that the actual divergence of character shown, is at the expense of the animals' and plants' vigor of constitution, and of their fertility; and that, instead of such divergent varieties diverging into distinct species, they diverge inevitably to sterility and to death! They show that the exclusive possession, of any positive character, by any variety of a species (which is necessarily implied by divergence of character), is to the detriment of the individuals of the other varieties of the same species. They show, that the possession of any negative feature, or the reduction, suppression, or absence of any character, or a different ratio of the development of the characters, from that of the original type, is injurious. They show, that there cannot be more than one variety, of any species, consistent with physiological integrity; and that Darwin's divergent varieties are but injurious modifications of such normal variety which is the sum of all the possible characters of the given species.

The phenomena of Crossing, and the phenomena especially of Close-Interbreeding, have long been the occasion of a spirited controversy between two schools (as they may be called), intent, the one on affirming, and the other on denying, the fact that the alleged effects do flow.

The question, particularly, whether evil effects result from Close-Interbreeding, became of moment, with them, not because of its intrinsic importance,

but by reason of the implications, it was fancied, its determination carried with it. Those who were of a "liberal" cast of thought, wished, by establishing the negative, to prove that the inhibition of religion against marriages of consanguinity, is wholly arbitrary, and that it has no justification, upon natural grounds. The other school are, for obvious reasons, bent upon showing that such intermarriages may not be contracted, with impunity.

On the one side, the almost universal aversion to such marriages, is adduced. The lowest and most degenerate tribes of men are pointed out as holding it in the most abhorrence. Nor does their evidence end here. The lower animals and plants contribute testimony which is seemingly well nigh overwhelming. The sterility of well-bred pigs, and of the high fancy breeds of pigeons and of fowls, when interbred, are noted; aye, so peculiar are the evil results, in many instances, that it is generally remarked, that the very improvements, which man effects in Pigs, Pigeons, Fowls, and Plants, seem only to aggravate the evil results of Interbreeding. The many instances, of Self-Impotent Plants, also furnish evidence so pronounced, that it would seem that the voice of cavil should be hushed.

On the other hand, those who contend that evil does not result from marriages of consanguinity, advance facts which are equally impossible to be gainsaid. They argue, that, although the aversion to interbreeding is general, the fact that the prohibition obtained with the least force among the most civilized nations of antiquity, and the fact that it is observed

most religiously by the most degenerate tribes of Africa, show that it is a mere superstition, lingering traces only of which prevail, and prevailed of old, among the most cultured nations. Egypt, they say, even in the zenith of her civilization, observed the prohibition not at all; and, they contend, that the prejudice has ever been least, in the regions around the Caucasus, where the proportionate development of Man implies intellect above the average. The history of the Ptolemies, whose frequent intermarriages between brother and sister, during a period of 300 years, are attested by history, affords, they contend, conclusive proof that evil does not result. The history of Cleopatra, the last sovereign of that dynasty, though not the last descendant, was certainly not, they urge, that of a person, in whom any mental or physical degeneracy was observable; although, they concede, with delicate irony, that her moral comportment may have, to some extent, betokened the evil.

Nor is it to Man only, they say, that they must look for evidence to sustain their position. Horses, sheep, and cattle have been bred, *inter se*, in the closest relationship, for generation and generation following generation; yet, no evil resulted; but, on the contrary, the animals displayed marked improvement. Many special instances are given, where the horse has long resisted breeding, in-and-in, between the nearest relations. The Leicester sheep have been bred in-and-in, over sixty years, without the introduction of a single new ram into the flock. With Cattle, the bull, "Comet," is a well known instance of very close interbreeding.

Its pedigree, and that of its descendants, are frequently quoted. Another equally remarkable case, is that of

"The famous bull, Favorite (who was himself the offspring of a half brother and sister from Foljambe"), which "was matched with his own daughter, granddaughter, and great-granddaughter; so that the produce of this last union, or the great-granddaughter, had fifteen-sixteenths, or 93.75 per cent. of the blood of Favorite, in her veins. This cow was matched with the bull Wellington, having 62.5 per cent. of Favorite blood in his veins, and produced Clarissa: Clarissa was matched with the bull Lancaster, having 68.75 per cent. of the same blood, and she yielded valuable offspring" (Darwin's *Animals and Plants, &c.*, Vol. ii, p. 146).

These instances, they hold, show conclusively, that evil effects do not result from close-interbreeding, or from marriages of consanguinity; that, there is something wrong, or suspicious, about the cases, implying that evil does follow; and, that, to sum up the whole question, the prohibition against marriages of near relations, is but another device of priestcraft to hold the ignorant in bondage.

The further these schools advance their accumulations of facts, the worse confounded, seemingly, grows the problem; and, the cream of the joke lies in this, that each side taunts the other, with the imputation, that those of the other school have no practical knowledge of the subject, or they would not deny, what is established by the experience of all breeders. The retort to this, by either, is, the confrontation, of their opponents, with facts, respectively, showing no evil,

and showing great evil; and the cynical query, how the others avoid the inference from such phenomena?

Those, to whom it never has occurred, to consider whether interbreeding may not be merely the *occasion* of the evils entailed, and not the *cause*, have long been puzzled to know, to which side, the balance of the evidence inclines. If disciplined in scientific habits of thought, they find,—when assured as to which side has the preponderance of testimony,—that such assurance aids not at all to extricate them from their quandary. For, what is, then, to be done with the residual facts,—the well attested phenomena, advanced in support of the argument on the other side? There will still remain, to plague the man who has settled, in his own mind, that the weight of the evidence is on a particular side, a perplexing array of facts, which are as far from being resolved scientifically, as they are impossible to be gainsaid. If the conclusion achieved be, that interbreeding does cause evil, how deal with the many instances showing, that close interbreeding may be carried on, in the closest degree of relationship, for generation upon generation; and which refuse to be moulded into even seeming accordance with such conclusion? And, if the other opinion be adopted, there equally remains a number of similarly stubborn facts, which refuse to conform to any such award.

There was, once, a man named Buckle. This man commenced to write what he termed a "History of Civilization in England." Happily, for civilization in England, he, his demise made, before the work was half finished. He plumed himself upon being an in-

ductive philosopher (it was lucky that he did, as his readers would have never suspected it); and represented his mode of discovery of sociological, ethnological, and other truths, to be a process peculiarly positive and scientific. The process was this: He relied solely upon statistics: When a problem presented itself, he carefully added up such of the figures, in said statistics, which to him appeared to refer to that side, of the question, which he fancied to be the truth. He also added the figures on the opposing side: He compared them: If the sum on the side, first mentioned, preponderated; the question was, then, scientifically and positively resolved. All cavil at the result, could be naught but the emanation of an ignorant and superstitious mind, fatally bent upon being perverse.

To give the man his due, in candor it must be stated, that, if the sum, of those figures, in the statistics, which pertained to. the side, from which his prejudices leaned, was greater than the sum of those on the side he favored, he yielded his preconceived opinion, and deferred, with grace, to the statistics; for, from them, it was scientific heresy, to hold, there could be any appeal. Thus, the "liberal" tone of his mind would have occasioned a predilection for the side which contended, that no evil results from close interbreeding; as the ascertainment of such to be a fact, would show that the religious command, to abstain from consanguineous marriages, was a senseless prohibition. If, however, he had added up his little sums, and had found the testimony of experience to be (to

the extent, only, of one, two, or half a dozen instances), preponderant in favor of the view, that evil does result; he would have declared, upon the infallible authority of those statistics, that evil always does result from close interbreeding, or from consanguineous marriages; and this, despite his laudable desire to curtail the tyranny which priestcraft exercises over the vulgar, —principally, by withholding from them, all statistics!

Darwin is a disciple of Buckle (in the second volume of his "*Animals and Plants under Domestication*," the former, in a plaintive tone, regrets that Mr. Buckle's rigid processes of discovery precluded his acceptance of the evidence, showing Inheritance, because the results had not been formulated in statistics, and were, therefore, not susceptible of addition, and of comparison, by sums). Following out Buckle's process, and prompted thereto by an ulterior aim to which we shall later advert, Darwin affects to believe that, in the solution of the question of interbreeding, where there is such an amount of conflicting evidence, it merely behooves him, to ascertain the weight of the different testimony, and then to determine for the side, which he finds preponderant. The weight of the testimony appears to be overwhelming, in favor of the view, that evils do flow from interbreeding. Therefore, he concludes, that evil inevitably follows, and is always eventually caused by the mating of relations. The exceptional phenomena are allowed to care for themselves. As he postulated "an innate tendency," to stop all inquiry into the cause of variations, so he here lumps all of the phenomena of crossing and of

close-interbreeding, and ascribes them to "a great law of nature,"—a mode of explanation which obviously is naught but a rendering of his ignorance into the semblance of knowledge. He remarks (p. 327, *Origin of Species*):

"How ignorant we are, on the precise causes of sterility;" and, he says (on p. 109, *Origin of Species*), "that close interbreeding is a general law of nature, utterly ignorant though we be of the meaning of the law."

Thus he states his "great law of nature" (p. 109, *Origin of Species*):

"I have collected so large a body of facts, showing, in accordance with the universal testimony of breeders, that, with animals and plants, a cross between different varieties, or between individuals of the same variety, but of another strain, gives vigor and fertility to the offspring; and, on the other hand, that close-interbreeding diminishes vigor and fertility; that these facts alone incline me to believe that it is a general law of nature (*utterly ignorant though we be of the meaning of the law*) that no organic being fertilizes itself for an eternity of generations; but that a cross with another individual is occasionally,—perhaps, at very long intervals,—indispensable."

If it be "a general law of nature," that evil should flow from close-interbreeding, and that good should result from crossing, why do not the same degree of evil, and the same degree of good, result, respectively, from crossing, and from close-interbreeding, in different individuals, when there is a like degree of relationship, or a like distinction between the animals or plants coupled? We should at least, expect a like

degree of good, and a like degree of evil, when there is a like degree of relationship, or of distinction, in individuals of the same species. Why do the evil effects of close-interbreeding, recur, at different periods, with different individuals of the same species? Why is close interbreeding of such doubtful, and varying effect? Why is it so problematical, in any given degree of interbreeding, whether evil, or good, will result? Why is it, that good frequently results, from this process, when by "a general law of nature," as Darwin has it, evil is essentially inherent in such a process? He himself says, again and again, that close-interbreeding is that process, upon which breeders mainly rely, to effect improvement in their breeds. He also shows, that different species of animals and plants, are differently affected, by the same degree of interbreeding; and that different animals and different plants, of the very same species, are also differently affected. The effects of the same degree of interbreeding, are also shown to be different, in different varieties; different, in individuals of the same variety; different, in individuals of the same herd or flock; different, in individuals of the same family; aye, different in flowers on the same plant; different, in flowers on the same bough or branch; and different, in flowers on the same twig!

The good, from the same degree of crossing, likewise, differs, in the same way. Why this inconstancy? Why this variability, in the effects which follow, if there be "a great law of nature?"

Why is it, if the evil effects are due to interbreeding,

per se, that, with the same degree of interbreeding, with different individuals of the very same species, fertility graduates from zero to perfect fertility?

Why is it, that, with horses, sheep, and cattle, very little evil effects are observable? and, that, with some individuals of those species, no evil whatever follows, however long continued, and close the interbreeding may be?

Why is it, on the contrary, that with pigeons, fowls, and pigs, the greatest evil is the outcome of any degree of interbreeding, even when there is no relationship of blood? Why is it, that, with a short-beaked tumbler, for instance, interbreeding is not possible, without great evil resulting, even when the individual is interbred with another of the same variety, which is removed from it, in blood, for thousands of generations, and which was reared in a distant country?

Why is it, that, with cattle, sheep, and horses, varying degrees of evil are observable, in different individuals of the same species, and in different individuals of the same breed, from the same degree of close-interbreeding; and that, in some individuals, there are no evil effects? Why is it, that, with pigeons, fowls, and pigs, varying degrees of evil are observable in different individuals of the same species, and in different individuals of the same variety, from the same degree of interbreeding?

Why is it, that with pigeons, fowls and pigs, the more highly improved the varieties are, the greater are the evil effects; and, the less improved that the varieties are, the less are the evil effects? Why is it,

that the highly cultivated pig is susceptible of the greatest evil effects; and that the least-cared for pig,—the one which is forced to root around, for its living,—displays little, or no evil effects, from the same degree of close-interbreeding? Why is it, that the more widely divergent the varieties of a species are, the greater are the evil effects from interbreeding? and why is it that the increase of good, from crossing, is the greatest with them?

Why is it, that the most well-bred animals, of the horse, sheep, and cow species, are the ones which need the least crossing, to ward off lessened fertility, when it is the finest bred animals among the pig, pigeon, and fowl species, which require it the most?

Why is it, that the more that varieties realize Darwin's divergence of character (which, according to his view, is to convert them into distinct species), the greater is the need, that they be crossed in order to avert the sterility and delicacy of constitution which, he asserts, always accompany such divergence of character?

Why,—to urge the most significant of questions, the answer to which involves a full refutation of Darwinism,—are the individuals of a divergent variety, which Darwin deems an "incipient species," sterile, or partially so, when interbred together; and, why are they of greatly increased fertility, when crossed with individuals of other divergent varieties of the same species; when the individuals of a species, are generally fertile with each other, and absolutely sterile (or produce absolutely sterile hybrids), when crossed with individuals of another species?

Possibly, it is below the dignity of "a great law of nature," to resolve such trivial details.

In some cases, there are no such effects as are alleged by Darwin. In the other cases, there is such an infinite variety, in the quantity of the effects, that the mind instinctively spurns such a makeshift of ignorance, as is Darwin's "law of nature," ascribing the good which results from Crossing, to Crossing, *per se*, and the evils resulting from interbreeding, to interbreeding, *per se*.

The objections here urged against his "law of nature," are not mere objections; they are disproofs. For, the facts, adverted to, are not only left unexplained by his doctrine, but are wholly subversive of it.

The confusion, prevailing upon the subject, has been only augmented, made worse confounded, by Darwin's senseless generalization. The subject, too, is one, a correct understanding of which, is absolutely necessary to correct principles of breeding. There is, probably, no necessity, more imperatively felt, than that of a knowledge of the cause of the effects of crossing, and of close-interbreeding. Darwin has committed himself to a general proposition which, a very slight consideration of the facts, should have shown him, to be both unsustainable, and absurd. There are published, at the present time, by the veriest and most unlearned of tyros, in the veterinary art, works on breeding, in which the "law of nature," which Darwin propounds, is contemptuously rejected, as plainly incompetent to cover the facts; and, in

which, is intimated the existence of some other, and true law, which, while rendering explicable all the many variations in the quantity of the effects, and the frequent absence of all such effects, will show close-interbreeding to be but a mere condition.

Infinitely varied as are the facts of crossing, and of close-interbreeding, they are susceptible of easy and simple resolution, when the fact is recognized, that want of integrity of structure, in the individuals of any species, entails, in proportion, a want of physiological integrity; and, that, when such want of integrity of structure is repaired (as it is in crossing, through each parent contributing to the offspring, a positive character which the other parent lacks), a proportionate return to physiological integrity, is secured.

Upon this principle, every one, without exception, of the various perturbations, to which the reproductive elements are observed to be subject, becomes perfectly explicable, and susceptible of both qualitative and quantitative prevision. This explanation accords, most rigorously, with each and every one of Darwin's tens of thousands of facts,—whether of sexual, or of asexual reproduction. Each one, of the thousands of individuals of each species, will, when questioned, by means of this rule, respond, and give the degree of its departure from the original, perfect type of its species. The evil effects of close-interbreeding, are faithful indications of the degree of such departure; and, the increase of good from crossing, is an indication of the degree of return, which has been made towards such type. By this rule, moreover, the different data,—

esteemed so mutually incompatible,—of those who concur in, and of those who demur to Darwin's conception, are shown to be in perfect harmony with each other. All the discord is harmony, when understood. The variations in the quantity of the results of crossing and of close-interbreeding, are a mighty maze, but not without a plan. Each degree of effect, answers, faithfully, to a corresponding degree of the cause assigned; and, where the cause is observed to be absent, there the effects are seen not to prevail.

The theory of reversion,—or theory of the necessity of the proportionate development of all the characters of a species,—explains, in the simplest manner possible, all and each of the many different variations in the quantity of the effects of crossing, and close-interbreeding; and explains the irregular recurrence of such effects. By it, scientists, and every breeder, fancier, horticulturist, and agriculturist, are enabled to solve the question, why there exists such a gradation, even within the same species, between those individuals evincing the greatest evil effects, and those displaying the least, or none at all; by having disclosed to them, in the cause, a corresponding gradation, between those individuals, lacking a large number of characters, or having them disproportionately developed to the greatest degree, and those individuals possessing all, or nearly all of the characters of their species, fully and proportionately developed.

It is in the similar departure, of each of the parents interbred, from the true mould, or original type of their species, that we find the cause of all the disorder

manifested in the general organization, and of all the disorder in the reproductive system. The power of propagation, in the parents, and the constitutional vigor of the offspring, are lessened, in proportion to the amount of departure from the sum of all the characters; and are increased, in proportion as the individuals return to that type. It is not relationship, which causes the evil. Relationship simply implies similarity of structure, in the parents. The evils of lessened fertility, and of lessened constitutional vigor, are displayed, when the parents are similarly disproportionately developed, similarly wanting, or similarly defective, in features of their species.

The loss, or reduction, of any characters, is deleterious to either parent: When the parents pair, the evil, consequent upon such loss or reduction, is aggravated, or intensified. Thus, there are one hundred and fifty different varieties of the pigeon. The members of each divergent variety, necessarily lack the positive peculiarities of the other varieties. If, then, two of the same variety interbreed, the evil, entailed by the absence of the positive peculiarities of the other varieties, is intensified.

Full health of the whole, or full functional activity of the whole organism, subsists, not in the development of some parts, or of some organs alone, but solely in the full development of them all. Perfect fertility, or perfect, constitutional vigor, consists only with the sum of all the positive features of the species. The capacity of the reproductive elements, is dependent upon the full representation, therein, of all the

parts. Where, then, some of the parts are not present, the reproductive capacity is impaired; and, if there be a certain number of characters wanting, absolute sterility sets in. Harmonious play and movement of all the parts, as in a mechanism, is requisite. There must, as a *sine qua non* of physiological integrity, or of normal coördination, be perfect exactness,—the closest fitting in of each part. "All must full or not coherent be," And all must rise (*i. e.*, revert), in due degree. If "'Tis but a part we see, and not the whole," the organism is *thrown out of gear* (to use a Yankeeism).

An individual, of any species, can exist in a perfectly healthy, normal state, only as a whole;—that whole, which comprises all the positive features of its species; and, it is a fundamental and egregious error, to suppose that,—as with pigeons and fowls, under domestication,—the characters of the respective species may be divided among many different varieties, consistently with physiological perfection. It is an error, also, to suppose, that the characters which, in the well-bred (?) pig, are reduced or suppressed, may be so reduced or suppressed, without evil being entailed. It is an error, also, to suppose that the true ratio of the development of the characters, respectively, of the horse, sheep, and cattle, may be varied in the individuals of those species, without detriment to their fertility and constitutional vigor.

Either, immediately, as with fancy pigeons, with fancy fowls, and with highly cultivated pigs; or, in course of time, as with well-bred horses, cattle, and sheep,—dependent, always, upon the degree of dis-

proportionate development of the individuals,—will the individuals, when interbred, dwindle, grow feeble, become of lessened fertility, and eventually grow sterile.

If a great number of characters, of the respective species, be reduced, or suppressed, the evil will ensue immediately, with any individual bred with another of the same variety; although there subsist between the two, no degree of relationship. If the number of characters so lost or reduced, be a degree less, the evil will, either, be less, from the same degree of interbreeding; or be the same, from interbreeding with a distant relative. If, still less, be the loss or reduction, the evil will, either, be less from the last mentioned degree of interbreeding; or, be the same, from interbreeding with a relative, a degree nearer. If, less, again, be the disproportionate development, the evil will, either, be less, in the last named degree of relationship; or, be the same, only, with a nearer relative (say), a cousin. If, less, still, the evil will, either, be less, with the cousin; or, be the same, if the interbreeding, with a cousin, be continued for more than one generation; or, be the same, from an intermarriage of father and daughter, or of mother and son. If the reduction, or suppression, of characters, be small, the evil will, either, be less from the interbreeding of a son and mother, or of a father and daughter; or, be the same, if such interbreeding be continued for more than one generation; or, be the same, if the intermarriage be between brother and sister. If the organisms approximate the full and

proportionate development of all the characters of their species, the evil will, either, be less, from the intermarriage of brother and sister; or, be the same, if the interbreeding be carried on for more than one generation. If the approach to the original type of the species be nearer, the interbreeding of brother and sister, may be carried on, for many generations; but, the effects of the slight disproportionate development, will begin to tell, after some period of such long-continued close-interbreeding.

If there be no reduction or suppression of any of the characters of the species, and no disproportionate development whatsoever, the original type is then realized, and interbreeding may be carried on, *ad infinitum*, in any degree of relationship, however close, without any evil effects; provided, of course, the individuals, in question, always retain their full integrity, and, that each of those individuals with which any such interbreeds, is alike the sum of all the positive features of the species.

The above descending scale of effects obtains, of course, only where the law of inheritance fully operates, where like produces like, and where relationship actually occasions, what it generally implies, viz., similarity of defects. The effect is due, to each parent lacking like points of structure, and to the aggravation, or augmentation of such evil, in the offspring.

The evils, from close-interbreeding, grow less and less as the integrity of the organism is repaired or regained; or, they grow greater and greater, in pro-

portion as the animal or plant recedes from the original type of its species.

The close-interbreeding, of those which answer to the original type of their respective species, is attended with no evil whatever.

Darwin attributes every imperfection, existing in the offspring of parents related in blood, to the fact of consanguinity alone; which is manifestly absurd. For, even if there be no consanguinity, or relationship between the parents, but there be similarity of defects, the result is the same; and, if there be consanguinity, and no structural defects, there will be no evil entailed. Consanguinity, *per se*, adds not a jot nor a tittle to the evil effects.

Mere relationship has not any influence, in producing the evil effects. Given, full and proportionate development, the *same blood* is in no wise injurious. There is nothing necessarily pernicious, in a marriage of consanguinity. It occasions evil, generally, merely because, it is far more likely for parents, which are descendants of the same near ancestor, to have similar defects, than it is, for those not bound together by any tie of blood. The nearer the connection, between the individuals paired, the greater is the probability of evil in the offspring; but, solely because, such blood relationship generally implies, that the defects which every individual has, more or less, will be similar, in the pair so related, and thus augmented in the offspring. The more remote is the connection between the couple, the less, the other things equal, will be the probability of evil; for, remoteness of connection generally implies

dissimilarity of development. If the connection be very remote, there is even some probability, that good, instead of evil, will result from pairing; for, it is likely, that though the parents may, perhaps, be equally defective, their defects may lie, in each, in a different portion of the structure, from what they do in the other; and, thus such, or some of the defects, in either, may then be supplied, in the offspring, by corresponding, positive developments, in the other.

There is evil wrought upon the aggregate of every organism, in proportion to the amount of characters which are reduced or suppressed. The breeding of one such individual, with another, defective in exactly the same characters, aggravates the evil. The reason, and the sole reason, why relationship enters as an element into the problem, is because the ratio of the development of the characters, is similarly incomplete. To produce evil, the ratio of development of the characters must, in the animals interbred, be a like, false ratio. If a true ratio, no evil follows; if a false ratio, but not a like ratio, good instead of evil may flow; for, the deficiencies in the ratio of each, are likely, then, to be supplied by positive quantities in the ratio of the other.

Two cousins may be seemingly free from all defect; but, nevertheless, may possess, and most probably will possess, a similarly disproportionate development. Lessened fertility, and loss of constitutional vigor, in their offspring, will then be displayed, through the evil of the disproportionate development, above assumed, being intensified by the progeny's having transmitted to it the accumulated evil.

On the other hand, two cousins may marry, who are equally disproportionately developed, and as much so as were the pair last assumed; and no evil be observed to result. The reason will be; the relationship does not, in such instance, carry with it similarity of defect. Although equally disproportionately developed, they are not similarly so. Relationship, even when there are defects, does not always or necessarily imply similarity of defect, in form or structure. One of the two cousins, may,—where the bond of his relationship with his cousin, was his maternal grandmother,—have inherited his structure from, either, his paternal grandfather, or paternal grandmother, or from his maternal grandfather; or, where his parent, who was of kin to his cousin, was his mother, he may have inherited his structure wholly or in great degree, from his father. If he derived a structure from either of these, or from all conjointly, or from some only; and, if his maternal grandmother had thus no influence in determining his features of growth; it is manifest, that the circumstance of his wife being his cousin, could not occasion any evil in his offspring.

To ascribe the difference, in the quantity of effects from the same degree of interbreeding, to unlikeness, *per se*, or to likeness, *per se*, is absurd. Such an explanation is little more than a mere restatement of the phenomena; or, rather, a restatement of some only of the phenomena. For, such an hypothesis fails to cover many facts,—facts which are not merely left unresolved, but which conclusively negative such an idea.

Herbert Spencer attributes the differences in the effects to likeness, and to unlikeness, *per se;* and, it is amusing to note the pretentiously philosophical manner in which he gives back to his readers, as an explanation, *the very facts which he essayed to explain for them!*

Individuals, realizing the perfect type, will be absolutely alike; yet, they are the very individuals which are exempt from any evil, from any degree of close-interbreeding; whereas, if they interbreed with individuals unlike themselves, their offspring will be of lessened fertility, and of lessened vigor; because, such unlike individuals will necessarily be defective in some character, in order to be unlike those of the perfect type.

It is not mere unlikeness; it is unlikeness of defect, which abates, or precludes the evil effects; and it is not mere likeness, but likeness of defects, which causes or, rather, aggravates, the evil. Where two animals are deficient in the same endowments of their species, there is no or little chance of repairing those portions of the organism's balance; but, rather, an almost inevitable necessity of augmenting those faults, in the offspring. When, however, they are dissimilarly defective, there is a strong probability, that the faults of either will be remedied, in the offspring, by positive, corresponding features in the other. Defects in each, or some defects in each, will be supplied by an excellence which the other derives, perhaps, from an ancestor, not common to the former.

Darwin says (p. 84, Vol. ii):

"Certain individuals are prepotent, in transmitting

their likeness. * * * It would appear that, in certain families, some one ancestor, and, after him, others in the same family, must have had great power in transmitting their likeness through the male line; for we cannot otherwise understand how the same features should so often be transmitted after marriages with various females, as has been the case with the Austrian Emperors, and, as, according to Niebuhr, formerly occurred in certain Roman families, with the mental qualities. The famous bull, Favorite, is believed to have had a prepotent influence on the short-horn race. It has also been observed with the English race-horse, that certain mares have generally transmitted their own characters, whilst other mares, of equally pure blood, have allowed the character of the sire to prevail."

When an individual, with a positive character, strongly developed, mates with another, with the same character less developed, or indifferently well developed, or somewhat reduced, the former will be prepotent, in such character, over the other; because the character mentioned, will, other things equal—for instance, if the same character, in the less potent parent, be not so much reduced, or so wholly suppressed, as to diminish, in the offspring, the size of the character—be transmitted to such offspring. The reason why, in these cases, the smaller development, of the character, in the less potent parent, does not obtain to diminish the size of the character, as it exists in the prepotent parent, is because, there still remains, in the less potent parent, the power of reversion in such character, which concurs with the same character, in the prepotent parent, to keep it up to the high state of development.

This is borne out by observation; for, as a general rule, when an individual is prepotent, the features which evidence the prepotency, are characters which are positively and strongly developed. This is the case with the likeness of the Austrian Emperors, with the likeness of the Stuarts and others, which, were displayed by strongly-marked facial features.

The line of Judah, it may here be remarked, would never have continued so long as it has, in despite of interbreeding, had not the Jews been broad-faced, and of strong facial features, implying proportionate development in other respects. The extermination of the Puritan race is not wholly due to the cause so generally assigned by physicians. The "hatchet-face" of the Yankee, and the corresponding development of the rest of his frame, are answerable for much of the sterility which has awakened inquiry into the said "social evil." The matrons of New England have been sinned against most vilely, in this regard, by ignorant and presumptuous sciolists. The race is fast being run out; but its women, at least, should not be suffered to pass away, unrelieved of a load of unmerited obloquy.

Mental characters obey the same rule of prepotency; as they are ever dependent upon structural conformations—upon particular coördinations of cerebral tissue. If, however, characters, in any individual, are positively developed in structure, but through disuse, or other cause, have become rudimentary in function, any individual, of corresponding, negative characters, with whom the former mates, may be prepotent.

Another rule, which may be observed to obtain, in determining prepotency, is, that, if any given ratio (whether of a positive, or of a negative cast) of the development of the characters, of the species, has been long maintained, either through interbreeding, or through the long-continued, fortuitous mating of individuals similar in development, the product of such a line will generally be prepotent, even when mated with individuals, with characters whose usual effect would be to alter or amend such ratio.

With respect to the prepotency of sex, adverted to above by Darwin: While such prepotency is frequently explicable, upon the above principles, it is also amenable, frequently, to another rule. Many characters are correlated, either directly or indirectly, with both primary and secondary sexual characters. Both the sperm, and the germ, undergo, before fecundation occurs, an independent, though very small development, just appreciable by the microscope. If the congression of the two transpires, when the spermatozoön, for instance, has advanced, but little, in its development, and after the ovum has run much or all of its course of little, independent development, the female element will have, not only the power of impressing its special, sexual coördination upon the fœtus, but will often, perhaps, have also the power to influence the development of the characters, common to both sexes, but which are correlated, in some respects, with the female's primary or secondary, sexual parts. As this physiological law is operative, in so many ways which are determined by an equal variety of degrees of the respective develop-

ment of either, and of both, of the sexual elements, it is proper to reserve the full treatment of the question until the phenomena of generation engage our attention.

A case, illustrative of the rule, that prepotency is due, frequently, to the long maintenance of a given ratio of development, is to be found in the following remark of Darwin (p. 89, Vol. ii, *Animals and Plants, &c.*):

"A purely bred form of either sex, in all cases in which prepotency does not run more strongly in one sex than the other, will transmit its character, with prepotent force over a mongrelized and already variable form."

There is another reason for this phenomenon, besides the fact, that the prepotent form has long been persistent in its peculiar type. The reason is an obvious one, upon the theory of reversion. To Darwin, this, with all of the other facts on breeding, is inexplicable. Having vitiated his theory at the start, by leaving the question of the cause of variation, or improvements, unresolved, it is incompetent to the explanation of any of the phenomena.

In the "mongrelized and already variable form," all of the characters of its species, or the major portion of them, are striving to revert to the original, full development, proper to the perfect type. No one, of the characters, is predominant; or, if there be one or more advanced in development, it is very little in the ascendant. When crossed with "a purely bred form," which has (especially when it belongs to a widely divergent variety), one character, of its species, most decidedly developed, this "purely bred form" becomes prepo-

tent, in the offspring; because its pronounced peculiarity, concurs solely with the corresponding character in "the mongrelized and variable form," and aids its development alone, and not that of the other characters. The consequence is, that the offspring resembles more the purely bred form. It could not well do otherwise. If it resembled the mongrel form, the influence of the strongly marked character in the "purely bred form," would be left unaccounted for; whereas, when the result is as is seen, in the prepotency of the "purely bred form," all of the influences of the several characters, in either form, are manifest. This prepotency is explained, simply, as the resultant, of the accession of one very dominant force, to a like, but lesser force which is one of many equal forces.

Darwin says (p. 92, Vol. ii, *Animals and Plants, &c.*):

"On the whole, the subject of prepotency is extremely intricate. * * * It is, therefore, not surprising that every one hitherto has been baffled in drawing up general rules on the subject of prepotency."

If the improvements, and positive variations observable, had been recognized, as the mere regain of impaired integrity; neither he, nor others, would have been so baffled. Darwin's error has lain, in ignoring physiology; and, in confining himself, exclusively, to anatomical tests,—to mere diversities in structure, without ascertaining whether those diversities had any effect upon the general system of functions. Anatomy and physiology are correlative sciences, each being the complement of the other; and neither may be well

studied, or understood, without the other. It is a fact, beyond all question, that Darwin, so far from striving to resolve the physiological phases of his problem, is systematically bent upon rendering them worse confounded. It is possible, that he is moved to such a course, by an uneasy consciousness that their explanation would confound all of his speculations. Be that as it may, however, there is no doubt, whatever,—for, it is by him explicitly avowed,—that his design, in adducing the facts of physiology, is to show that they cannot be explained, and, then, from the impossibility of accounting for them, to deduce the conclusion, that the insuperable objection to his theory, the sterility of hybrids, is an argument which cannot be relied upon as conclusive, as the whole subject of fertility and sterility is incomprehensible. This flimsy device will be completely unraveled in the succeeding chapters of this work.

Two Classes of Evil Effects occasioned by Close-Interbreeding:

There are two classes, of the evil effects, which are occasioned by close-interbreeding.

The one class, comprises the effects wrought upon a part, or parts, in the offspring, by the mere augmentation of the structural defects, in such part or parts, in the parents.

The influence, however, which the reduction, or suppression of any part, exerts, does not stop with the said reduction or suppression of such characters; but, entails evil upon the aggregate,—upon the organization, as a whole, and upon the reproductive elements.

The evils entailed upon the aggregate, upon the organization as a whole, and upon the reproductive capacity, constitute the second of the two classes.

In all organisms, there is, normally, a reciprocal balance of all the organs, and parts, of the respective species. The maintenance of this balance, constitutes full physiological perfection; and, when any part or parts are wanting, or reduced, this balance is impaired; and an evil effect is wrought, which is over and above the mere deficiency in the parts. The evils, entailed upon the aggregate, are loss of fertility, and of constitutional vigor.

The deficiency, in parts, sometimes works no appreciable functional derangement, in such parts, or in the adjoining parts; although a deficiency, whether working functional derangement or not, in the part, always effects some functional derangement, in the aggregate. But again, quite frequently, the slightest possible loss of tissue, will occasion deleterious effects upon the parts involved, of the most serious character; while, the effect upon the aggregate, or upon the coördinating force of the whole, is infinitesimal, as in blindness. If cousins married, who, in the structure of the eye, were slightly deficient, but not so deficient as to produce, in them, any inconvenience, or consciousness of their defect, their offspring would, possibly, then, have said defects augmented, and be wholly, or partially blind. If such couple were proportionately developed in other respects, the evil upon the aggregate, would never be appreciably displayed, in any degree of close-interbreeding, however long-continued. The degree, in

which the offspring's fertility and constitutional vigor would be affected, would be proportionate, simply, to the small amount of tissue, which was wanting in the structure of the eye,—which effect would be, practically, *nil*, even if the offspring and their descendants interbred, brother and sister, for thousands of generations.

A long catalogue could be given, of all sorts of evils, in parts, which are augmented in close-interbreeding; but, whose effect is, of itself, little upon the coördination of the whole; viz., cerebral affections, apoplexy, epilepsy, insanity, gout, consumption, asthma, stone in the bladder, amaurosis, hypermetropia or morbid long sight, myopia or short sight; and, in horses, for instance, ring-bones, curbs, splints, spavin, founder, roaring, or broken and thick wind, melarosis and blindness.

Contradistinguished from these effects upon the parts themselves, are the effects upon the aggregate; which Darwin cannot explain. They are lessened fertility, sterility, loss of constitutional vigor, and a general breaking up of the whole constitution.

A man may have all of the specific diseases, to which flesh is heir; yet, if he be otherwise proportionately developed, in all the characters of his species, he, and his descendants, may go on, for many generations, interbreeding as close as did the Ptolemies, and remain of undiminished fertility. The impairment of the balance, would be in proportion only to the amount of tissue destroyed, in the parts so affected, and not to the degree of the diseases' ordinary, baneful influence.

This proportion, too, would not be a direct one; for, if the diseases involved many parts, their symmetrical effect would measurably poise the balance which, action in one part alone, would have more disturbed.

A man, however, very disproportionately developed, may be free from all specific diseases; yet, if he breed with even the most distant of traceable relatives, he probably will, either, be sterile, or give birth to offspring which will be sterile; and he, and his offspring, will be of much weakened constitution. The well-bred (?) pig, with the regulation reduction of legs, of snout, of front of the head, of tusks, and with bristles suppressed, may be free from all particular diseases, yet it will most probably be sterile with even distant relatives, and even with others of the same breed; whereas, the pig that roams the woods for a living, and has the characters, above mentioned, proportionately developed, instead of having them reduced; may have every disease, peculiar or common to pigs, yet it will be very prolific, in any degree of close-interbreeding.

Darwin cannot understand why this is so. He can appreciate, how there is evil from the mere augmentation of morbid tendencies; or, how there is evil in particular parts from the aggravation of the parents' defects in those parts; but, he is at a complete loss, to understand how, or why, the effects upon the aggregate, and upon the reproductive system, are wrought. His idea, that he may vary an animal or plant, *ad lib.*, and mould it, to any form he pleases, precludes his arriving at the truth, namely, that normal coördination consists solely with the development of all the parts of the given

species; that full capacity of the reproductive element requires a full representation therein, of all the forces of all the parts of the species; and, that, when any of the parts fail to contribute their quota, of force, to such reproductive element, the capacity of such is lessened, and impaired, in proportion.

He says (p. 144, Vol. ii, *Animals and Plants, &c*):

"That evil directly follows from any degree of close-interbreeding, has been denied by many persons; but, rarely, by any particular breeder; and never, as far as I know, by one who has largely bred animals which propagate their kind quickly. Many physiologists attribute the evil, exclusively, to the combination, and consequent increase of morbid tendencies, common to both parents; that this is an active source of mischief, there can be no doubt. It is, unfortunately, too notorious, that men, and various domestic animals, endowed with a wretched constitution, and with a strong hereditary disposition to disease, if not actually ill, are fully capable of procreating their kind. *Close-interbreeding, on the other hand, induces sterility; and this indicates something quite distinct (!) from the augmentation of morbid tendencies common to both parents.* The evidence, immediately to be given, convinces me that it is a great law of nature" ("Law of nature" was an excellent good term, before it was ill sorted; therefore, scientists had need look to it), "that all organic beings profit from an occasional cross with individuals, not closely related to them in blood; and, that, on the other hand, long-continued close-interbreeding is injurious. Various general considerations have had much influence in leading me to this conclusion; but the reader will probably rely more on special facts and opinions. The authority of experienced observers, even when they do not advance the grounds of their

belief, is of some little value. Now, almost all men who have bred many kinds of animals, and have written on the subject, such as Sir J. Sebright, Andrew Knight, &c., have expressed the strongest conviction, on the impossibility of long-continued close-interbreeding. Those who have compiled works on agriculture, and have associated much with breeders, such as the sagacious Youatt, Low, &c., have strongly declared their opinion to the same effect. Prosper Lucas, trusting largely to French authorities, has come to a similar conclusion. The distinguished German agriculturist, Hermann von Nathusius, who has written the most able treatise, on this subject, which I have met with, concurs."

It is thus seen, that Darwin, while rightly conjecturing the cause of the evil effects upon the parts of the organism, is puzzled, respecting the cause of the effects wrought upon the aggregate—effects which are evidenced in loss of fertility and of constitutional vigor.

The experienced breeders and writers, of whom he speaks, are unquestionably right, in their conclusion that, as a fact, such effects do most frequently result. But, they do not all refer them to "a great law of nature," or to any other such "innate tendency," or similar, metaphysical entity; and, then complacently imagine that they have explained (!) them. Fancy the perfect howl of derision, which would be set up, by the mutual admiration society of English philosophers, were a person, suspected of being tinctured with orthodoxy, to attempt to shirk the solution of a body of facts, by referring them to "a great law of nature!" Breeders, whilst recognizing the truth of the facts, advanced by Darwin, are not so obtuse, as to disre-

gard the significance of the important circumstance, that the effects of the same degree of close-interbreeding, vary widely, not only with individuals of different species, but also with individuals of the same species, and even of the same variety, and of the same breed, both in the quantity of the evil, and in the period of its recurrence. It is a consideration, of these circumstances, which moves many, even of the unlearned, to scorn such an unphilosophical mode of induction (or deduction, for it is hard to tell what it is), as Darwin essays, when he postulates, or deduces, "a great law of nature!" It would afford inexhaustible amusement, to know what Darwin's major premise is, if his "great law of nature" be a conclusion. It must be, in the similitude of this: Phenomena, which are scientifically inexplicable, are due to a "great law of nature;" the phenomena of close-interbreeding, are scientifically inexplicable; Ergo: the phenomena of close-interbreeding are due to "a great law of nature." If his law be an induction: the mere intimation, to such effect, should suffice to start Bacon from his grave, to deplore the time, the event shows that he wasted, in warning his disciples against the error of incomplete induction.

Breeders see, that, with such variations in the quantity of effect, attendant upon close-interbreeding, the process itself cannot be the cause, but must be the occasion only. What the cause is, they are at a loss to say. But, they can well see, that in-and-in breeding is not the cause.

A scientist, however, who may,—as Darwin has

done, with full impunity, and with the hearty concurrence of the scientific world,—deduce a law of indefinite progress, from what the very terms of his problem show, to be but instances of regain of developments previously lost; who founds his theory upon an "innate tendency," or upon ignorance; and, who, throughout all of his works, makes his ignorance enact the role of positive factors, may well, and confidently, count upon the implicit reception of any absurdity which he may see fit to devise, to hide the inconsistencies of his hypothesis.

All of the exceptions, here taken, to Darwin's "law of nature," as applying to close-interbreeding, obtain, *mutatis mutandis*, with equal force, when urged against the other phase of his "law," which applies to Crossing. The same variations in the quantity of the effects, from the same degree of crossing, are observable.

When each, of two individuals paired, has much to contribute, to the offspring, which the other lacks, the good, resulting from such cross, is great. Where each has but little to contribute, which the other lacks, the good resulting is small. If but one of the parents has any characters to contribute to the offspring, which the other lacks, the increase of good, in the offspring, will be such only, relatively to the parent whose deficiencies were supplied, and which had naught to give, but what the other parent also gave. When good results to the offspring, relatively to both parents, as it generally does; it is because, defective parts in either, are supplied, by positive parts in the other,—through each of the

parents having something to bestow, where existed defects in the coördination of the other.

If proof of this principle be required, observe all of the cases of crossing; note the amount of structure, which is possessed by either parent, and which is wanting in the other; mark the advance towards structural integrity, made upon the parents, by the offspring; and, then observe the constant relation, subsisting between the gain, to the offspring, in fertility, and in constitutional vigor, and the advance, made by such offspring, in mere, structural development.

Note the great improvement, in fertility, and in constitutional vigor, resulting from crossing two widely divergent varieties, of pigeons, which have, each, an important, and strongly pronounced character, which the other does not possess. Note, on the other hand, the comparatively little increase in fertility, and in vigor, which follows from crossing two well-bred varieties of the horse, of the sheep, or of the cow species, which are distinguished from each other, by but some slight differences in the ratio of the development of their characters.

In order to demonstrate, that the good effects, occasioned by crossing, are due to the increased return, made by the offspring, to the structure of the original type, which possessed all of the characters of the given species, it is not necessary to invent any metaphysical entity; to seek refuge behind any "great law of nature," fashioned for the nonce; nor to appeal to any gratuitous supposition, which is, besides, incompetent to explain the many differences in the quantity of

the effects. The reason alleged, is founded on the observed results of breeding, as detailed by Darwin; is in the strictest accordance with every variation in the results; is a reason, not merely deduced from the law of reversion, but supported and confirmed by daily experience; and is the only reason, or explanation, which covers all of the phenomena.

To Darwin, the good, resulting from crossing, is as insoluble, as are the phenomena of close-interbreeding; or (to use a simile of his own, respecting the cause of variations), as insoluble as the problem "of free will and predestination." The phenomena of crossing, are also, by him, relegated to the mysterious operation of the same "great law of nature," to which he refers the phenomena of close-interbreeding. Controversialists, speculating upon the problem of free-will and predestination, might acquire from Darwin, light to guide them through their theological mazes. If he, Darwin, may, within the realm of nature, resolve a body of conflicting phenomena, by ascribing them to "a great law of nature;" may not a theologian, with equal (aye, immeasurably greater), propriety, resolve his transcendental difficulties, by ascribing all the points for which he contends, in the controversy respecting Free will, to "a great supernatural law!!"

He says (p. 213, Vol. ii, *Animals and Plants, &c.*):

"Abundant evidence has been given, that crossing adds to the size, vigor, and fertility of the offspring. This holds good, even when there has been no previous close-interbreeding. It applies to individuals, of the same variety, but belonging to different families,

to distinct varieties, and partially even to species. In the latter case, though size is often gained, fertility is lost."

Even if Darwin had perceived, that the contribution, to the offspring, by either parent, of a character which answered to the part deficient in the other parent, could furnish an explanation of the good resulting from crossing; such a solution upon the hypothesis of evolution, would not be so satisfactory, as it is upon the theory of Reversion. For, upon the theory of Reversion, the characters, supplied to the offspring, are characters which were once lost, the regain of which, is needed to secure perfection; whereas, upon the theory of evolution, there is no explanation, of why the mere addition of characters, should bring with it, increased fertility: seeing, that species, with a small number of characters, are generally as fertile, and sometimes more so, than species, with a development greatly more complex. Neither would there be any assignable reason, upon Darwin's theory, why, where there was, in each parent, a positive peculiarity, and a defective character, the defective character should not be prepotent over the positive character, and evil result, in the offspring, through the defects in either, sinking the corresponding, positive developments in the other parent.

The reason, why good, instead of evil, results, when two individuals, dissimilarly defective, are crossed, is, because, in the defective points of each, the power of reversion exists, ever ready to assert itself, under conditions in anywise favorable; and, this capacity joins

with the other parent's positive characters which correspond, to effect the development of such characters in the offspring, and a return, full or measurable, as the case may be, to the perfect type. If this power of reversion were not present, there would be no reason, why the defective points of each parent should not, in the offspring, be prepotent, over the positive peculiarities of the other; instead of, as is the fact, the positive peculiarities of the one, supplying the deficiencies of the other. It is true, that, under certain unfavorable conditions, militating against the operation of reversion, the defects in each or in one, may be, to some degree, prepotent over the positive features in the other. Such a phenomenon, however, is rare. When such is the case, however, there is always to be observed an abatement, or absence, of the good, ordinarily resulting from crossing. This explains the few cases, where, as Darwin shows (with reluctance, because they contravene his law), no good, and even evil, result from a cross.

Crossing undoes, either wholly, or in a measure, the injury attendant upon a departure from the original type;—restores, in a degree, to the offspring the vigor and fertility which defects in development, had, in the parents, destroyed or impaired. It is by the conjunction, in the offspring, of the positive characters in which either parent differs from the other, that the good is effected. It is not the mere addition of structural parts, but the consequent, improved physiology, which secures the benefit from a cross.

Darwin says (p. 142, Vol. ii, *Animals and Plants, &c.*):

"The gain in constitutional vigor, derived from an occasional cross, between individuals of the same variety, but belonging to distinct families, or between distinct varieties, has not been so largely, or so frequently discussed as have the evil effects of close interbreeding. But the former point (the gain in constitutional vigor, which is derived from crossing) is the more important of the two, inasmuch as the evidence is more decisive. The evil results from close-interbreeding, are difficult to detect, for they accumulate slowly and differ much in degree, whilst the good effects which almost invariably follow a cross, are from the first manifest."

In the following Chapters, we shall trace in detail, the truth of the principle of Reversion in its application to Crossing and Close-Interbreeding; and show that, however widely the several species may differ in the results of the several modes of Selection to which they have been subjected, they all establish and confirm, most positively, the theory that the evil results, of Close-Interbreeding, are due to the absence, in the individuals, of characters proper to their respective species; that the good results, from Crossing, are due to each of the parents' contributing, to the offspring, a character or characters which are absent in the other parent; that there is but one normal type, for each species, which is the sum of all the positive characters of such species; that no positive variation is possible, in any species, after the members thereof, have regained all the characters which the species once lost; that any modification, or departure from the perfect type of a species, is attended by physiological evil which is merely aggravated by Close-Interbreeding;

and that any return to such type, whether effected by direct Reversion, by Crossing, or by Grafting, is attended by a physiological regain, or abatement of the evils entailed by the loss or reduction of characters.

The space available would not suffice for all the proofs on hand; so, it has been deemed advisable, merely, to furnish evidence respecting one or more of those species which principally illustrate either of the four more pronounced modes of Selection.

Pigeons and Fowls constitute the subject of one Chapter, because they both represent the mode of Selection by which lost characters, of a species, are indeed all regained, but regained only to be apportioned among distinct varieties, and not developed, all, in each variety.

Pigs form the subject of another Chapter, because they represent that mode of Selection, pursued by breeders, by which characters, of a species, instead of being developed, are reduced and suppressed.

Horses, Sheep, and Cows constitute the subject of another Chapter, because they represent the mode of Selection by which the lost and reduced characters, of a species, are (comparatively speaking) all concurrently regained and re-developed in each individual or variety, and a very close approximation to the full and proportionate development of all the parts, of a species, effected.

Plants form the subject of another Chapter, because they illustrate the effects flowing from that mode of Selection which develops to a great, or to the extreme point, one only of the characters of a species; and,

principally, because they show that Reversion explains the seemingly-inexplicable results of Crossing, of Close-Interbreeding, and of Self-Fertilization, even when there prevail such infinite variations in the quantity and quality of those results, as are known to obtain with Plants.

Numberless other evidences,—showing that any departure from the type of the sum of all the positive characters of the species, is fraught with proportional evil upon the aggregate, as well as upon the parts involved, and showing that any (proportionate) return to the perfect type (however effected), issues in an abatement of such evil,—could be furnished from Darwin's own notes of the breeding of Dogs, Rabbits, Bees and, in fact, of all the domestic animals. The reader, however, will doubtless concur in the opinion that, after the testimony adduced in relation to the Crossing, Close-Interbreeding, and Self-Fertilization, respectively, of Plants, Pigeons, Fowls, Pigs, Horses, Sheep, and Cows, all further proofs, in support of the theory of Reversion, and in Refutation of Darwinism, may justly be dispensed with.

CHAPTER VIII.

The Crossing and the Close-Interbreeding of Pigeons and of Fowls.

Each of the species, Pigeon and Fowl, affords a crucial instance of the truth of that theory of interbreeding, which is deducible from the assumption of reversion.

It has already been shown in Chapter vi, on The Processes of Formation of Varieties, that, with Pigeons and Fowls, all or most of the characters, respectively lost or reduced by those species, have been regained, not concurrently, but each character, in a different variety. Man, it has been shown, there looks to the development of only one of such lost or reduced characters, in each variety. In the Fantail, the character, which such name connotes, is alone regained, and its development pushed to an extreme point; whilst the rest of the long-lost or reduced parts are suffered to remain respectively reduced, and suppressed. In the Pouter variety of the Pigeon, the individuals "show" such "adaptation to his (man's) wants and pleasures," and "have been" so "modified not for their own benefit, but for that of man," that the individuals of this variety (for instance), lack all, or nearly all, of the positive peculiarities of the other one hundred and forty-nine varieties of the said species.

Not only is the principle illustrated, in these two species, the Pigeon and Fowl, of a distribution, among several and distinct varieties, of the characters regained; but, the effects of all the other processes of the formation of varieties, are also observable, in varieties of these two species. Disproportionate development, with the varieties of these species, is effected, not merely by failure to develop all of the characters, concurrently, in each individual, but also by direct degeneration,—by the direct suppression or reduction of features which had escaped the ordeal of the Struggle for Existence.

Such species should, *ex hypothesi*, be notable for evil effects when their individuals are bred in-and-in. If, for instance, the individuals of the Fantail variety which is below referred to, lack not only the full development of the peculiar character of their variety, but lack also, all of the positive peculiarities of all the other varieties of their species,—which they needs must,—it is manifest, that interbreeding will, by the physiological effects, wrought upon such individuals, decide positively, one way or the other, whether evil flows, from the departure of the individuals from the type of the sum of all the positive features of their species.

If the individuals of a variety, not only lack all the positive peculiarities of the other varieties, but are distinguished from the others by a negative, instead of a positive, feature, the evil effects of close-interbreeding should, *a priori*, be the greater.

Darwin says (p. 237, Vol. ii, *Animals and Plants, &c.*):

"A great winner of prizes at the Pigeon shows, in de-

scribing the shortfaced Almond Tumbler, says, 'There are many first-rate fanciers who are particularly partial to what is called the goldfinch beak which is very beautiful; others say, take a full-sized round cherry, then take a barley-corn, and judiciously placing and thrusting it into the cherry, form as it were your beak; and that is not all, for it will form a good head and beak, provided, as I said before, it is judiciously done; others take an oat; but as I think the goldfinch beak the handsomest, I would advise the inexperienced fancier to get the head of a goldfinch, and keep it by him for his observation.' Wonderfully different as is the beak of the rock-pigeon and goldfinch, undoubtedly, as far as external shape and proportions are concerned, the end has been nearly gained."

When it is remembered, that, not merely is the beak, in this variety, moulded according to the fashion, caprice, and fancy of man, in violation of the true proportion which is essential to physiological integrity; that, not merely does it lack, from eighteen to twenty-eight (of the forty) tail-feathers, of the Fantail variety, together with its power of erection of the same; that, not merely does it lack "the wonderful development of the head," "the greatly elongated eyelids," the "very large external orifice to the nostrils," and "the wide gape of mouth," of the Carrier; that, not merely, also, does it lack the "great size," "long, massive beak," "large feet," the "very long neck," and the "very long wings, and tail" of the Runt; that, not merely does it lack the "much elongated body and legs," and "the enormously developed crop," of the Pouter; that, not merely does it lack the "line of reversed feathers, down the breast," of the Turbit;

that, not merely does it lack "the feathers, so much reversed, along the back of the neck that they form a hood," of the Jacobin; and, that, not merely does it lack the power of utterance of the coo, alone retained by the Trumpeter and Laugher; but, that it also lacks, to a greater or less degree, development in the size, and shape of the body; in the number, and size of the scutellæ; in the size of the eyes, and eyelids; in the length, and breadth of the tongue; in the amount of wattle; in its coating of feathers; in the size, and shape of its sternum, and of its scapulæ; in the number, and size of its vertebræ, and in many details of its skeleton, and of other internal and external organs; it is apparent, that here, in this variety, and in the other divergent varieties of the species, which are, *mutatis mutandis*, likewise, disproportionately developed, the greatest evils are to be expected from close-interbreeding, and the greatest increase of good, from crossing distinct varieties.

The Fowl has its characters, similarly distributed, among its different varieties, and similar, evil effects are, therefore, to be expected to result from close-interbreeding.

It is also to be expected, that, when two varieties, of the Pigeon or of the Fowl, are crossed, good will result; owing to the fact, that some of the characters which one variety lacks, will be supplied by the characters which the other possesses.

The results anticipated, *ex hypothesi*, are fully borne out, by the facts recorded by Darwin. (It is scarcely necessary to reiterate again, that the facts are inexplica-

ble by him; for, they are all inexplicable, by him. The sum of his insight into the phenomena he has collated, is, that "the stronger and more vigorous survive." If enlightenment should be sought, by a breeder, upon any one of the million of facts contained in "*Animals and Plants under Domestication*," Darwin would answer, that, upon that subject, "our ignorance is profound;" but, the breeder would be assured, that, of his descent from a monkey, there was neither ignorance, nor doubt.)

The following quotation, from Darwin, establishes, conclusively, the point maintained. Not only is the absence, in any given variety, of the peculiarities of the other varieties, prolific of evil; but, the further the development of the peculiarity of the given variety, is pushed, the greater becomes the evil; because, such development, by making such character more and more predominant, augments the disproportion, and vitiates the true ratio of development of the characters of the species. It is, also, to be remarked, that, where the degeneration of any character is desirable, with fanciers, the evil, wrought by close-interbreeding upon such part, will not be esteemed an evil, because it subserves the object designed by the fancier. The evils, however, which are wrought upon the aggregate, and which display themselves in lessened fertility and in delicacy of constitution, are, all other things equal, the greater in such a case.

"*With Pigeons*," says Darwin (p. 150, Vol. ii, *Animals and Plants, &c.*), "*breeders are* UNANIMOUS, as previously stated, *that it is absolutely indispensable*,

notwithstanding the trouble and expense thus caused, occasionally to cross their much-prized birds with individuals of another strain, but belonging, of course, to the same variety. It deserves notice, that when large size is one of the desired characters, as with Pouters, the evil effects of close-interbreeding are much sooner perceived, than when small birds, such as shortfaced tumblers, are valued. *The extreme delicacy of the high fancy breeds*, such as these Tumblers, and improved English Carriers, *is remarkable, they are liable to many diseases, and often die in the egg, or in the first moult; and, their eggs have generally to be hatched under foster mothers.* Although these highly prized birds have invariably been subjected to much close-interbreeding, yet *their delicacy of constitution cannot, perhaps, be thus fully explained.* Mr. Yarnall informed me, that Sir J. Sebright continued close-interbreeding some owl-pigeons, until from their extreme sterility, he as nearly as possible, lost the whole family. Mr. Brent tried to raise a breed of Trumpeters, by crossing a common pigeon, and re-crossing the daughter, granddaughter, and great-granddaughter, with the same male trumpeter, until he obtained a bird with fifteen-sixteenths of Trumpeters' blood; but then the experiment failed, for 'breeding so close, stopped reproduction.' The experienced Neumeister also asserts, that the offspring from dovecotes, and various other breeds, are 'generally very fertile, and very hardy birds;' so again MM. Boitard and Corbié, after forty-five years of experience, recommend persons, to cross their breeds for amusement; for, if they fail to make interesting birds, they will succeed, under an economical point of view, 'as it is found that *mongrels are more fertile than pigeons of pure race.*'"

"Pigeons of pure race" lack many of the characters of their species. "Mongrels" possess two characters,

and frequently more, where either of their parents possessed one; hence, the greater fertility of the mongrels. The reason that dovecotes, trumpeters, and common pigeons, "and various other breeds," are, compared with the "high fancy breeds," "generally very fertile and hardy birds," is because, whilst in the "high fancy breeds," one character, or more, is pushed to an extreme point, the development of the characters, in the dovecotes, &c., is nearer to the true proportion. Although many of the characters are reduced, they are reduced, in these breeds, in something like proportion.

The extreme delicacy, and sterility, of the "high fancy breeds," of pigeons and fowls, should be borne in mind, by the reader; for, as will be seen, these traits conclusively negative Darwin's conception, that these divergent varieties may diverge into distinct species.

Darwin speaks, above, of the mongrels from a cross, not being "interesting" birds. The reason they are esteemed, "not interesting," to the breeder, is, because they have the characters of the species, approximating concurrent, and proportionate development; whereas, no pigeons are "interesting," to men happily termed "fanciers," unless they have one, or a few characters, pushed to the extreme of development, and out of all proportion to the others. The "interesting" birds, have to pay for their charms, by the "delicacy of constitution," and the "sterility," which are so "remarkable."

"EVIDENCE OF THE EVIL EFFECTS OF CLOSE-INTERBREEDING," says Darwin (p. 145, Vol. ii, *Animals and*

Plants, &c.), "CAN MOST READILY BE ACQUIRED IN THE CASE OF ANIMALS SUCH AS FOWLS, PIGEONS, &c. * * Now, I have inquired of very many breeders of these birds, and *I have hitherto not met with a single man who was not thoroughly convinced, that an occasional cross with another strain of the same sub-variety, was not absolutely necessary.* Most breeders of highly improved, or fancy birds, value their own strain, and are most unwilling, at the risk, in their opinion, of deterioration, to make a cross. The purchase of a first-rate bird, of another strain, is expensive, and exchanges are troublesome; yet all breeders, as far as I can hear, excepting those who keep large stocks, at different places, for the sake of crossing, *are driven, after a time, to take this step.*"

The reason, why "evidence of the evil effects of close-interbreeding, can most readily be acquired, in the case of animals, such as Pigeons, Fowls, &c.," is insoluble by Darwin. He simply records the fact, without attempting to explain it. The real reason, is, because the varieties of these species are divergent in character; and divergence necessarily implies disproportionate development. For, it takes many positive characters to make many divergent varieties, and such characters, instead of forming peculiarities of several classes within the same species, are all, according to the theory of reversion, needed in each individual of the species. Consequently, it is to be expected, that, when these characters, instead of being concurrently developed, in each individual, are apportioned among different varieties, and when the true integrity of the species, is thus impaired, some evil or injury must follow; and, as Pigeons and Fowls are the species, wherein the true

proportion of their respective characters, has been thus most outraged, it is, to them, one should look, for the greatest evil effects from interbreeding individuals, similar in the defects of their development.

Each one of the varieties, respectively, of the Pigeon, and of the Fowl, lacks all of the positive characters which form the distinguishing marks of the other varieties of the same species. As, therefore, the absence, in any variety, or individual, of any character of its species, must, *ex hypothesi*, be deleterious to its physiological integrity, there is little room for marvel at the evil results of the close-interbreeding of these animals.

There is as little occasion, to wonder at the good which, Darwin alleges, results from crossing two varieties of any one of these species. For, as he elsewhere says, they "differ in an extreme degree, in some one part, when compared with one another" (p. 16, *Origin of Species*). When two such varieties are crossed, the offspring acquires some character, or characters, which either of its parents lacked, and so much the nearer is the approximation, in the offspring, to the original, perfect type; hence, the good resulting.

These two species, the Pigeon, and the Fowl, are the species, upon the divergence of character in whose varieties, Darwin mainly relies, to show that varieties are "incipient species," or distinct species, in the process of formation. Yet, in the very exposition of his hypothesis of such divergence, he reveals a state of facts, which signally confutes such a view. For, he clearly shows, by his remarks (which are frequently

reiterated) concerning the evil results of interbreeding the highly improved or fancy birds, and concerning the absolute necessity of crossing them with individuals of the other varieties, that this very divergence of character, is in derogation of the fertility and constitutional vigor of the individuals of the divergent varieties;—aye, incompatible, when carried to any great extent, with their very existence; for, he says (p. 270, Vol i, *Animals and Plants, &c.*), that:

"*The young of all highly improved fancy breeds, are extremely liable to disease and death!*"

This shows conclusively, that the further that this process of divergence (upon which he counts to evolve the varieties of any species, into distinct species), is carried, the nearer, step by step, do the varieties, so divergent, approximate complete sterility and extinction!

On the other hand, it is shown, by his remarks, already quoted, and by those quoted below, *that the only means, by which such divergent varieties may regain their fertility, and retrieve their shattered constitutions*, is, by *undoing the very process which, he would have his readers believe, evolves them into distinct species!*

Even though the phenomena of close-interbreeding, and of crossing, did not conclusively imply, that the sum of all the positive characters of the respective species, was the only, perfect type; what would be the strength of an argument, favoring the evolution of species, by means of divergence of character, when the individuals of each of the varieties, assumed to be so diverging into distinct species, meets with com-

pletely shattered constitutions, and with sterility, before they have half accomplished such process of divergence!

Not only do the phenomena of close-interbreeding, constitute an insuperable bar to any such result as evolution, into distinct species, by means of this divergence; but, the man is likewise blocked, in the other direction, by the fact of the sterility of hybrids!

If the proofs of reversion, the phenomena of close-interbreeding, the phenomena of crossing, and the fact of the sterility of hybrids, do not constitute the elements of a complete demonstration; then a demonstration is impossible, without the domain of mathematics.

Again, he says (p. 150, Vol. ii, *Animals and Plants, &c.*):

"*With all highly bred animals*" (he here obviously speaks of the animals which are divergent in character; for, he elsewhere says, "*with animals not divergent in character*, such as cattle and sheep, *interbreeding may be long carried on without any decrease in fertility or vigor*"), "*with all highly bred animals, there is more or less difficulty, in getting them to procreate quickly, and all suffer much from delicacy of constitution;* but, I do not pretend that these effects ought to be wholly attributed to close-interbreeding."

Strictly speaking, no evil is to be attributed to close-interbreeding. It is disproportionate development which causes the evil: Close-interbreeding but aggravates such evil. The "difficulty," of which he speaks, "in getting highly-bred animals to procreate," and their "delicacy of constitution," are in proportion to divergence of character, or rather to defects in struc-

ture which such divergence ordinarily implies. Each highly-bred, divergent variety obviously lacks all of the positive peculiarities of the other varieties of its species. It generally lacks even more characters, than these. The more varieties, with positive peculiarities, there are, within a species, the greater, generally, is the number of characters which each such variety lacks. Therefore, the evils of close-interbreeding tell sooner, and are the most disastrous, with the most divergent varieties.

Those who do not discern the method, in Darwin's seeming candor, may express surprise, that this constant relation,—traceable between lessened fertility, and the absence or reduction, in the individuals, of characters which belong to the given species,—should not have suggested itself to Darwin. But, it is manifest, that, if he saw this relation, it must have occurred to him, that it was to the interest of his strained hypothesis, that it should not appear; for, it forcibly, and necessarily implies, that all of the characters, possible to be developed in any individual, belong to each and every individual of that species; and, that divergent varieties subsist, in derogation of their full vigor and fertility.

But, why,—it may be urged,—is it, that Darwin states the facts, which thus tell against his hypothesis, so fully and so clearly? The reason is, that the possibility of such relation being perceived, was, to his mind, very remote; whereas, there stood, like Fate, confronting his hypothesis, the objection of the sterility of hybrids, which was an inevitable and well-

known difficulty in his way; and which, he saw, could be dodged, only by recording all of the complicated and seemingly inconsistent and inexplicable phenomena of the crossing and close-interbreeding of individuals of the same species, and, then, candidly (?) putting it to his readers, Whether any reliance could be placed upon the obvious inference from the sterility of hybrids, when the whole subject of sterility and fertility, both within the same species, and with different species, was in such an inextricable maze!

This accounts for his suicidal course, in adducing so plentifully, and so strongly, phenomena which show, that evil attends, degree for degree, departure from the one, normal type of any species. This expedient is (to borrow an expression, once used by George Henry Lewes, in another connection), "facile, but futile." For, the maze, in which the phenomena mentioned are involved, is not inextricable; the idea of reversion, and of proportionate development, being the thread, which resolves all of the confusion into the most beautiful harmony.

But, his device is equally futile, even upon the supposition, that the facts adduced, are not explicable. Explicable or not, both classes of phenomena confound all of his speculations. For, as the obvious inference, from the sterility of hybrids (even when such phenomenon is unexplained), is the negation of Darwin's theory; so, the obvious inference, from the sterility which attends divergence of character, is (even when such phenomenon is unresolved), in diametrical opposition to such theory. To take, then, these two

obvious inferences, and with each, gratuitously to attempt to cancel the other, is to perform a feat, never before surpassed by the most dextrous of intellectual jugglers.

Darwin says (p. 143, Vol. ii):

"It should, however, be clearly understood, that the advantage of close-interbreeding, as far as the retention of characters is concerned, is indisputable, and often outweighs the evil of a slight loss of constitutional vigor."

The expression "as far as the retention of characters is concerned," shows, that he means, that when a breeder is developing one lost or reduced, character alone, in a variety, in order to secure the dominance of that character, and the suppression or reduction of the other characters, it is necessary and desirable, to breed it closely with individuals possessing the same abnormal, or monstrous structure. He frequently reiterates an injunction of his, to breed from the "best" animals; when it is apparent, to every one who entertains the idea of reversion, even for an instant, that, with varieties in whose species there are many other varieties with positive peculiarities, those individuals, which are intimated to be the "best," are the ones in which disproportionate development invites the greatest evils, from close-interbreeding;—and, they are the ones which are really the more degenerate, the further the development of the special excellence of each, is pushed, because the proportion of the characters is thus marred.

With varieties, such as those of the Pigeon, and of

the Fowl, which, to the fancier, have their criterion of excellence, in the abnormally great development of one character alone, to the exclusion of the development of many other characters of that species, barrenness, and delicacy of constitution, are always prolific sources of trouble; and this trouble is always in proportion to the degree of "improvement," which the individuals of such divergent varieties attain. Of this, the "high fancy breeds" of the Pigeon and of the Fowl, are notable instances;—the very "improvement" of such breeds, is productive of the evils which usually accompany close-interbreeding.

Darwin, in the following remarks, ventures very close to the true law of development, and to the true reason of the evils, concomitant on interbreeding. The Bantam is wanting, in several characters of the Fowl species; and, of course, evil is attendant upon their absence. The true light seems just to glimmer, for an instant, upon Darwin's mental horizon:

"The Sebright Bantam is much less prolific" (p. 127, Vol. ii, *Animals and Plants, &c.*), "than any other breed of fowl, and is descended from a cross between two very distinct breeds, recrossed by a third sub-variety. But, it would be extremely rash to infer, that the loss of fertility was in any manner connected with its crossed origin, for it may, with more probability, be attributed either to long-continued close-interbreeding, or *to an innate tendency (!) to sterility, correlated with the absence (!) of hackles, and sickle tail-feathers.*"

It is strange, that, when Darwin can perceive such a relation between the sterility of the Bantam, and the absence of certain of the characters of its species, he

does not also discern the relation, which is observable, in every individual of every species, between its sterility, or the degree of its lessened fertility, and that amount of the characters of its species, which it lacks. It is equally strange, that such partial guess at the truth, has not led him further, and revealed to him, that the full and concurrent development of all the parts of a species, is essential to physiological integrity, and to full procreative power. It is, however, requiring too much to expect a theorist to develop such a "lead," when the absolute requirement of his hypothesis, is, that many of the characters of each species should be distributed, or apportioned, among several varieties.

One type alone, of each species, is normal. Nature errs not from her end, by the existence of a multiplicity of types (*i. e.* varieties), in a species. For, for each and every deviation from the one type, a penalty, commensurate with such departure, is visited upon the individual. Nature, then, does not deviate from the type prescribed; for every fact, in the whole of her realm, attests most clearly, that physiological integrity can be retained, only by strict conformity to the mould enjoined.

"Turning now to Birds," says Darwin (p. 154, Vol. ii, *Animals and Plants, &c.*), "*In the case of the Fowl, a whole array of authorities could be given against too close-interbreeding.* Sir J. Sebright positively asserts that he made many trials, and that his fowls became * * * small in the body, and bad breeders. He produced the famous Sebright Bantams, by complicated crosses, and by breeding in-and-in; and since his time, there has been much close-interbreeding with

these Bantams. I have seen Silver Bantams, directly descended from his stock, which had become almost as barren as hybrids; for, not a single chicken had been, that year, hatched from two full nests of eggs."

The proofs, which we advance, of the truth of the theory of Reversion, are, viz., the fact, that, with all of the individuals, which are most wanting in the characters of their respective species, there is the greatest evil, from close-interbreeding; and, the fact, that, with all of the individual animals or plants which most approximate full and proportionate development, there is the least degree of such evil. But, taking a single instance, there is none which presents such a delicate, crucial test of the truth of the theory of reversion, as the following remarkable case. The animal, mentioned below, advances, in but the slightest appreciable degree, to the perfect type of its species; yet, Darwin, who is wholly ignorant of the cause of the effect which he records, has remarked the physiological gain, which accompanies the slight, structural regain.

He says (p. 154, Vol. ii, *Animals and Plants, &c.*):

"I have noticed, as a general rule, that even the slightest deviation from feminine character, in the tail of the male Sebright (Fowl)—say, *the elongation, by only a half an inch, of the two principal tail-feathers (!)—brings with it improved probability of increased fertility!*"

In a note, to page 155, Vol. ii, *Animals and Plants, &c.*, Darwin says:

"See also the 'Poultry Book,' by Tegetmeier, 1866,

p. 135, with respect to the extent to which cock-fighters found that they could venture to breed in-and-in, viz., occasionally, a hen with her own son; 'but they were cautious not to repeat the in-and-in breeding.'"

Again he says, on the same page:

"Mr. Wright states that Mr. Clark, 'whose fighting-cocks were so notorious, continued to breed from his own kind, till they lost their disposition to fight, but stood to be cut up, without making any resistance, and were so reduced in size, as to be under those weights required for the best prizes; but on obtaining a cross from Mr. Leighton, they again resumed their former carriage and weight.' It should be borne in mind, that game-cocks, before they fought, were always weighed, so that nothing was left to the imagination, about any reduction or increase in weight. Mr. Clark does not seem to have bred from brothers and sisters, which is the most injurious kind of union. * * I may add that Mr. Eyton, of Eyton, the well-known ornithologist, who is a large breeder of Gray Dorkings, informs me, that *they certainly diminish in size, and become less prolific, unless a cross with another strain is occasionally obtained.* So it is with Malays, according to Mr. Hewitt, as far as size is concerned."

"We thus see," Darwin continues, "that THERE IS ALMOST COMPLETE UNANIMITY, *with poultry breeders, that* when Fowls are kept at the same place, *evil quickly follows from interbreeding carried on to any extent*, which would be disregarded in the case of most quadrupeds. On the other hand, it is a generally received opinion that *cross-bred chickens are the hardiest, and most easily reared.* Mr. Tegetmeier, who has carefully attended to poultry of all breeds, says that Dorking hens allowed to run with Houdan, or Crevecœur cocks, 'produce, in the early spring,

chickens, that for size, hardihood, early maturity, and fitness for the market, surpass those of any pure breed that we have ever raised.'"

The reason, why these great evils prevail among Fowls, is, because each individual, either, lacks many of the following characters, or has them, in a greater or less degree, reduced; viz.: the beak, the comb, the spurs, sickle tail-feathers, head, neck, wings, legs, feet, wattle, hackles, ear-lobes, wing-feathers, vertebræ, coating of feathers, crest of feathers, &c. All of the breeds are but various modifications of the sum of all the characters, fully developed. It is apparent, then, that, generally, each of the breeds possesses some positive character or characters, which the other breeds lack. What he says, therefore, respecting the physiological advantages to be derived from crossing the breed, is exactly what is to be expected by one whom the conception of reversion has led to believe, that perfection resides, only in that individual in which no positive character, of its species, is wanting.

He says (p. 280, Vol. i, *Animals and Plants, &c.*), Fanciers "admit, and even overrate, the effects of crossing the various breeds" of fowls. On page 287, Vol. i, *Animals and Plants, &c.*, he again notes the fertility of the offspring of crossed breeds.

On page 229, Vol. ii, *Animals and Plants, &c.*, he again says:

"Domesticated varieties, such as those of the Dog, Fowl, Pigeon, several Fruit trees, and culinary vegetables, which differ from each other, in external characters, more than many species, are perfectly fertile,

when crossed, or even fertile in excess, whilst closely allied species are almost invariably in some degree sterile."

Each variety, of the Fowl, and of the Pigeon, is not only defective in the mere ratio of the development of its characters, but it also lacks many characters. Such disproportion entails the evils of close-interbreeding. Each variety possesses a feature which, if joined with that of another variety, will insure a step towards the original type. This conjunction of the characters of two varieties, in one individual, is effected by crossing; and, as a consequence, there is a beneficial effect.

Each variety moves along a separate, divergent line, towards the true mould of the species. This advance, however, produces more evil, than if all the characters were suffered to lie proportionately reduced; because the true ratio of the development of the characters, is greatly prejudiced by this exclusive development of one character. Only by the union of all the divergent lines of growth, may physiological perfection be attained; and, when two such divergent lines are united, in one individual, the evil is measurably lessened.

As he has asserted, that it is difficult to get highly-bred animals to procreate, so he says again, that (p. 271, Vol. ii, *Animals and Plants, &c.*): "*Highly-bred animals are liable to degeneration.*" As has been more than once asserted, a multiplicity of divergent varieties, in any species, implies the absence, in each, of what constitutes the peculiarities of the other varieties. It is the disturbance of the balance of the characters,

occasioned by pushing these peculiarities to an "extreme point," which causes the pronounced degeneration of the highly-bred animals.

With respect to Pigeons, which are more divergent in character, than even the Fowl, he says (p. 27, *Origin of Species*):

"The hybrids, or mongrels, from between all the domestic breeds of Pigeons, are perfectly fertile. I can state this from my own observation purposely made, on the most distinct breeds. Now, it is difficult, perhaps impossible, to bring forward one case of the hybrid offspring of two animals clearly distinct, being themselves perfectly fertile."

In the chapter on "The Sterility of Hybrids," it will be seen how strongly this militates against his theory.

"Pigeons" (p. 29, *Origin of Species*) "were much valued by Abner Khan in India, about the year 1600; never less than 20,000 Pigeons were taken with the court. 'The monarchs of Iran and Turan sent him some very rare birds;' and, continues the courtly historian, 'His Majesty, by crossing the breeds, which method was never before practiced, has improved them astonishingly.'"

It is obvious, that, if the gain in sterility and constitutional vigor, resulting from crossing, be due to each parent contributing, to the formation of the offspring, a character or characters which the other parent lacks, the gain must be in proportion to the number of features so contributed; and, that the more distinct the crossed breeds are, the greater should be the good which flows. Darwin states, as matter of fact,—the

cause of which is wholly undreamt of in his philosophy,—that such is the case.

Says he, p. 236, Vol. i, *Animals and Plants, &c.*:

"MM. Boitard and Corbié affirm, after their great experience, that, with crossed pigeons, *the more distinct the breeds, the more productive are their mongrel offspring.*" (!)

The above quotation furnishes the key to the whole mystery of the good resulting from crossing. Apply this rule, to all of the many millions of animals of every species, and it will be found, that the increased good from crossing, is in proportion to the amount of positive characters, of the given species, which have been supplied, to fill a want, existing in either parent.

Darwin says:

"Varieties, however much they differ from each other in external appearance, cross with perfect facility, and yield perfectly fertile offspring" (p. 326, *Origin of Species*).

Aye; and, as he states above, the more that they differ, the greater is the increase of fertility, when crossed.

"The perfect fertility of so many domestic varieties, differing widely from each other in appearance, for instance, as those of the Pigeon, or those of the cabbage, is a remarkable fact; more especially, when we reflect how many species there are, which, though resembling each other most closely, are utterly sterile when crossed" (p. 327, *Origin of Species*).

Now, would any suspect, from the bland manner in which this last observation is made, that the obvious and admitted significance of the fact of the sterility of

species when crossed, militated most strongly against Darwin's theory? He is aware, as he shows by explicit statements made elsewhere to that effect, that such is the necessary import of the fact. Yet, here, instead of using a deprecating tone, in stating the fact, he records it, as though, if not strongly confirming his theory, it was in no manner,—apparent or real,—in opposition to his views of development. He resorts, throughout his works, most frequently, to this happy device, of obviating the adverse impression which the facts are calculated to awaken in the minds of his readers. This is a sample of the child-like and bland comportment, from which has enured to him, a reputation for candor. He is never candid, save when the facts are so well-known, that the absence of their mention, would recoil with hundred-fold force against his theory; or, where the facts are designed to subserve some ulterior aim he has in view. There are many facts, which come naturally within the scope of his work, which are, by him, quietly ignored. The fact of the sterility of crossed species, or of their hybrids, had to be stated; for, it would have been fully recognized as fatal to his theory, if urged first by an opponent. As its mention was inevitable, he does the next best thing to omitting it; he recites it, in a tone which seemingly goes very far to divest it of its dangerous effect upon his theory.

That it is possible, to combine the features of all the different varieties of a species, in one individual, is shown by the experiment of Darwin, recorded below. That, which has hitherto precluded the conception of

a perfect type for a species, has been the notion, that such a type would involve the union of all the varietal *types;* whereas, it is not the *types* which need to be united,—but the positive characters, those which are peculiar, and those which are common to the several varieties.

"All the domesticated races" (of the Pigeon), says Darwin (p. 235, Vol. i, *Animals and Plants, &c.*), "pair readily together, and what is equally important, their mongrel offspring are perfectly fertile. To ascertain this fact, I have made many experiments which are given in the note below; and recently Mr. Tegetmeier has made similar experiments, with the same result."

NOTE:—"I have drawn out a long table of the various crosses, made by fanciers, between the several domestic breeds, but I do not think it worth publishing. I have myself made, for this special purpose, many crosses, and all were perfectly fertile. I have united, in one bird, five of the most distinct races, and with patience, I might have united them all (!) The case of five distinct breeds being blended together, with unimpaired fertility, is important, because Gärtner has shown, that it is a very general, though not as he thought, universal rule, that complex crosses between several species are excessively sterile."

Again he says (p. 236, Vol. i, *Animals and Plants, &c.*):

"When we consider the great differences between such races as pouters, carriers, runts, fantails, turbits, tumblers, &c., the fact of their perfect, or even increased fertility, when inter-crossed in the most complicated manner, becomes a strong argument in favor of their having all descended from a single species."

Aye; and, when we consider that "increased fer-

tility" attends, degree for degree, the union, in any individual, of the peculiar characters of any two or more of these varieties, it becomes a strong argument in favor of there being but one normal type for the species Pigeon; and, becomes a strong argument, also, in favor of the view,—so strongly confirmed by the phenomena of close-interbreeding,—that any modifications of that type, such as are implied by the many great and positive differences between such varieties, work evil to the constitutions, and to the reproductive systems of the individuals. When Darwin had united, in one bird, five distinct varieties, he had, before his eyes, the closest approximation to the perfect type of the Pigeon, which he had ever beheld. Had he experimented further, with that bird, he would have found that its offspring could withstand, what no other Pigeons could possibly suffer, viz., long-continued close-interbreeding, for generation after generation, in the nearest degree of relationship, and without any, or with very little, evil effects wrought upon the constitution, or reproductive system.

Again, on pages 247–8, he cites as a "fact," that:

"All the races, though differing in many important points of structure, produce perfectly fertile offspring; whilst, all the hybrids which have been produced between even closely allied species, in the Pigeon family, are sterile."

It is, because the races do differ "in many important points of structure," that their mongrels are "perfectly fertile." Physiology demands, that all of those "many important points of structure," be com-

bined in each individual; as a *sine qua non* of full, functional integrity. The same good does not follow, from crossing species (such as the common pigeon, and the dove), because, as is obvious, there is not, in such a case, an advance to a common, perfect type; and, because, in a hybrid, the characters of the two species, are mixed together, in a manner, which precludes the actual coördination from being impressed, in miniature, upon the reproductive tissue; as is done, where the characters of the individual, belong to one and the same species.

With respect to this question, as it concerns the Fowl, he says:

"In considering whether the domestic breeds (Fowl) are descended from one species, namely, G. *bankiva*, or from several, we must not overlook, though we must not exaggerate, the influence of the test of fertility. Most of our domestic breeds have been so often crossed, and the mongrels are so largely kept, that it is almost certain, that, if any degree of infertility had existed among them, it would have been detected. On the other hand, the four well-known species of Gallus, when crossed with each other, or when crossed, with the exception of G. *bankiva*, with the domesticated Fowl, produce infertile hybrids. * * The argument of fertility must go for something."

The address, with which this delicate subject is here handled, would move the envy of Oily Gammon. Every one knows, and Darwin clearly understands, that an unanswerable objection to his theory, is the sterility of hybrids, which imposes an effectual bar to his confounding the species. Yet, with tact inimitable, he

requests his readers not to overlook (*sic*) the facts upon which the said objection is based! and gravely assures them that "the argument of fertility must go for something." Solicitous, however, lest his injunction, not to overlook the question of fertility, should be too fully complied with, he, with an air, exquisitely judicial, guards them, carefully, from running upon Charybdis, by warning them, that they "must not exaggerate the influence of the test of fertility." The state of mind, which is occasioned, in his readers, by this dexterous treatment of a witching point, is such, that they wholly waive the impression, by them first entertained; suffer vague doubts, respecting the validity of the objection, to enter their minds; modestly distrust their own capacity to gauge the question; and, end by fancying, that they owe a debt of gratitude to Darwin, for kindly arresting them, when they were on the very verge of metaphysics—which, an Englishman ever affects to regard, as his *bête noir*.

"The argument of fertility" does "go for something." What it "goes for," is, that the varieties are not "incipient" species; and, that they are physiologically incompetent to become distinct species: for, the individuals composing these divergent varieties lose their fertility, when bred among themselves, and approximate perfect fertility, only when crossed with individuals of a separate variety; whereas, species are notable, for having their respective individuals fertile, *inter se*, and sterile, when crossed with individuals of other species. Verily, "the argument of *fertility* must go for something;" but, it is refreshing, here to see

Darwin coolly advance such a proposition, when he is desirous of having the argument of *sterility* go for nothing.

"It is a singular fact," says Darwin, p. 305, Vol. i, "that the males, in certain sub-breeds (of Fowls), have lost their secondary masculine characters; and, from their close resemblance in plumage to the females, are often called 'hennies.' There is much diversity of opinion, whether these males are, in any degree, sterile; that they, sometimes, are partially sterile, seems clear, but this may have been caused by too close-interbreeding."

The mere absence of the said characters explains the sterility, partial or total. Each degree, of loss or of reduction of characters, entails lessened fertility, until that amount of modification is reached, which is the maximum compatible with any reproduction; then total sterility sets in.

"An experienced writer remarks," says Darwin, p. 155, Vol. ii, "that the same amateur (in Fowls), as is well-known, seldom long maintains the superiority of his birds; and this, he adds, undoubtedly is due to all his stock 'being of the same blood;' hence, it is indispensable, that he should occasionally procure a bird of another strain. But, this is not necessary, with those who keep a stock of fowls, at different stations. Thus, Mr. Bollance, who has bred Malays, for thirty years, and has won more prizes with these birds, than any other fancier, in England, says, the breeding in-and-in does not necessarily cause deterioration; 'but all depends upon how this is managed. My plan has been, to keep about five or six distinct runs, and to rear about two hundred or three hundred chickens each year, and select the best birds from each run for cross-

ing. I thus secure sufficient crossing to prevent deterioration.'"

It is plain, that, when Mr. Bollance says, that "breeding in-and-in does not necessarily cause deterioration," he shows, that he knows whereof he speaks, better than does Darwin. It is clear, that Mr. Bollance would not have formulated any "general law of nature," for a factor so infinitely variable in the quantity of its results, as is close-interbreeding.

The reason, why the evils of interbreeding, are lessened by keeping the animals at different places, is, because the different conditions, prevailing at such different places, entail slight differences in the growth of the individuals. Such slight structural differences suffice to stave off the evils attendant upon close-interbreeding. Different organs of the body, are differently affected,—either favorably or unfavorably,—in different places. This may be due to the differences in the food, in the air, in the water, or in the amount of exercise required for the legs and wings. These conditions act directly, upon the organs or parts obviously involved. But, differences of growth, are entailed in other parts of the organization, by correlation with the parts, immediately affected.

Thus, two individuals, derived from the same strain or family, will have their likeness to each other lessened, by being subjected to different conditions. When they interbreed, therefore, there is not the same amount of increased evil, that there would have been, had they been reared under exactly similar circumstances; for, there is not close similarity of defects; but each, proba-

bly, has, to contribute to the offspring, a little of positive structure in which the other is deficient.

The slight differences, which distinguish individuals in the same herd, or flock, will, in some cases, where such differences are positive, and where the degeneration, reduction, or suppression of the several characters, is not too far gone, suffice to avert the evils of interbreeding. They may avert them, for a time; or, make the evils manifest themselves, only when there is the closest interbreeding; or, after many generations of such close-interbreeding.

Darwin commends certain processes of selection by man, which involve the loss, to individuals, of characters of their species, and he also notes the evils of lessened fertility, and of lessened constitutional vigor, which follow the loss or reduction of any characters; yet, with the two terms of an obvious relation, thus clearly present to him, and while he even formulates such relation, he is conveniently obtuse to the fact, that it bears most conclusively against his theory. Thus, in the quotations given below, he approvingly quotes the reduction and the suppression of characters; and then remarks the deterioration, attendant upon such "serious defects in structure," and upon such violation of "the mutual relations of the parts." Yet, notwithstanding all, he pursues the uneven tenor of his hypothesis,—namely, that divergence of character will produce distinct species,—seemingly serenely oblivious of having mentioned anything which, in the least, militated against his views.

He says (p. 241, Vol. ii, *Animals and Plants, &c.*):

"It was ordered that the Polish cock should have no comb or wattles, and now a bird thus furnished, would be at once disqualified."

It will be remembered, that he has previously stated, that the absence of secondary, masculine characters, occasioned partial or perfect sterility.

He then states the induction (alluded to above), which, if he had any scientific acumen at all, should convince him, that he may not normally, or with impunity, mould organisms into any form he lists; but, that all of the characters of the species, are absolutely essential to physiological integrity.

"When man," says he (p. 273, Vol. ii, *Animals and Plants, &c.*) "attempts to breed an animal with some serious defect in structure, or in the mutual relation of the parts, he will either partially, or completely fail or encounter much difficulty, and this is, in fact, a form of natural selection. We have seen, that the attempt was once made, in Yorkshire, to breed cattle with enormous buttocks, but the cows perished so often, that the attempt had to be given up. In some short-faced Tumblers, Mr. Eyton says, 'I am convinced that better head and beak birds have perished in the shell, than were ever hatched.'"

The "better head and beak birds" to which he refers, means those with the smallest beaks and heads. The violation of "the mutual relation of the parts," does not end with this deterioration, in size, of the head and beak, but extends, by correlation with those characters, to the legs and feet; and is aggravated by the reduction, in such birds, of many other features.

"In order," he says (p. 283, Vol. ii, *Animals and Plants, &c.*), "that selection should produce any result, it is manifest that the crossing of distinct races, must be prevented. * * Although free crossing is a danger on the one side, which every one can see, too close-interbreeding is a hidden danger, on the other side."

In other words, crossing "must be prevented," because such a process would prejudice the special excellence of the breed, and imperil the predominance of the one part valued, by the development of the other parts. "Serious defects in parts," and "in the mutual relation of the parts," are what constitute the excellence of the birds, in fanciers' eyes; for the pronounced and exclusive development of some one peculiarity is what makes each variety so unique and valuable.

On the other hand, "too close-interbreeding is a hidden danger," because it is the Nemesis attending the suppression of those other parts, which are suppressed in order to throw the given peculiarity into prominence.

To put the whole philosophy of Darwin's double warning, in a nutshell: All the characters are necessary to be developed, in each individual; but, if the fancier desires individuals, with one character only well-developed, and with the other characters reduced or suppressed, he must take care not to cross, for that will be aiding the development of the characters which it is desirable should be suppressed; and on the other hand, he must look out for the evils which are visited upon the individuals, for having those other parts reduced, or suppressed.

Another close miss is made, below, at the true law.

"Facts teach us," says he (p. 282, Vol. ii, *Animals and Plants, &c.*), "a valuable lesson; namely, that we ought to be extremely cautious in judging what characters are of importance, in a state of nature, to animals and plants."

This question is solved, to a nicety, by the process of close-interbreeding. If great evil flows from such a process, there are many characters wanting, which are of importance: If no evils flow from any interbreeding, however close or however prolonged, all of the characters of importance are present in the individual: All of the positive characters of the given species, are in a physiological view, of importance; both, in a state of nature, and in a state of domestication.

It is manifest, that, if the theory of reversion, or proportionate development be true, it must be impossible for any of these divergent varieties to transmit its type for any great length of time, in an unbroken line of descent. Such is the fact. The long-continued interbreeding of animals, lacking so many of the characters of their species, would necessarily occasion debilitated constitutions incompatible with existence, and also occasion complete sterility. The history of the different breeds, respectively, of the Pigeon, of the Fowl, and of the Pig, reveals that such has been the case; that it is, and has ever been, necessary, frequently to replenish the stock of such breeds, by means of crossing, and by accessions, or the new selection of such varieties, from the races under nature, or from the less

divergent, and therefore the more proportionately developed varieties.

Darwin notices, that mention has been made, at intervals during the last three hundred years, of several varieties of the Pigeon, like those at present prevailing; and he tacitly assumes, that those varieties have been propagated, for that length of time, and that existing varieties are the pure, lineal descendants of those varieties. Now, the existing varieties cannot be traced, to any great period back. They are independently produced from the wild, or rock-Pigeon (*Columba livia*). It was impossible, for our fancy varieties, to have survived for the assumed length of time, without an immense amount of crossing. For, individuals, so disproportionately developed, as are those of the high fancy breeds, must inevitably die out, unless such violation of the true mutual relation of their parts, is retrieved by crossing, continually resorted to. The individuals are incapable of close-interbreeding, without injury; and, the further their divergence in character is carried, the more their eventual extinction is hastened. The only way that they may be able to survive, is at the cost of their distinguishing type, namely by crossing. When they have been crossed, interbreeding may be carried on for awhile; after which, to stave off extinction and sterility, they are compelled to take on other characters than those which distinguish their variety, and they suffer, thereby, both the decrease of their special excellence, and a relative abatement of its predominance. In this way only, may varieties, which lack any of the positive characters of their species, and

which have the development of one character alone carried to an extreme point, be saved from extinction. The following is the cycle, around which such abnormal types must swing: They diverge, in character; meet, in consequence, the plainest threat of absolute sterility and death from interbreeding; they then forsake their types, for the nonce, to retrieve, by crossing, the characters they need, to secure physiological repair; and then diverge, anew, to repeat again the same round.

Such a round, however, has not long been pursued, in the past. These divergent varieties have died out, from the evil effects which such an abnormal ratio of development of their characters has entailed. The seeming, long continuance of high fancy breeds of Pigeons, for instance, is due, not to those breeds having perpetuated their kind, for such length of time; but, to such breeds, having been recruited, from time to time, by accessions from the wild pigeon stock which, though degenerate, is yet of greater physiological value, owing to the proportion of the characters being better preserved, than it is in those breeds wherein one or more characters are given an undue ascendancy. It is impossible for any breed or variety, long to exist and preserve its type, when it lacks many of the characters of its species. Forms, and groups of forms, have disappeared from the earth. These forms, after having arisen, have spread and continued abundant for an era, and have eventually declined and become extinct. It is not necessary, to invoke cataclysms, with which to account for species having been swept from the face of the earth. Certain sets of con-

ditions are necessary for the full development of the characters of the several species. These conditions change. With the change in the conditions, comes the modification or suppression of certain of the characters. Such modification of structure, entails lessened fertility, and, eventually, absolute sterility. The Madeira beetles, for instance, which, Darwin says, have been compelled, by the prevalence of high winds, to reduce their wings to a rudimentary condition, are passing through a course of extinction. Such reduction creates lessened fertility, and lessened constitutional vigor. The accumulated action of interbreeding, will, in time, carry them off. Doubtless, other changes, in the conditions of life, will ensue, and will, by causing further modification of their form, hasten the sterility, which will end the species.

Evolutionists argue, that there is a harmony, in these adaptations, between the organism and its environment; that is, for instance, between the reduction of these beetles' wings and the high winds of their *habitat.* Whatever that harmony may be; there is no harmony, but an absolute incongruity, between the modified structure and a perfect, physiological state. There is, in one sense, a harmony subsisting between the fox who has gnawed off his leg, and the trap which closed upon Reynard's crural appendage. For, if the relation were not that of a trap and a dismembered fox, there soon would be no Reynard. But, perfect harmony, assuredly, cannot be here predicated. Vital, or Life harmony (as it might be termed), there doubtless is; but anatomical and physiological har-

mony, there, incontestably, is not. All of the instances of adaptation, shown by Darwin, are, when they involve a decrease of structure, instances which imply an advance towards sterility, and consequent extinction. Where the adaptations cited, show increase of structure, the adaptations are possible, only because they are the regain of structural integrity, previously lost. It has been urged, that it is gratuitous, to allege that an animal is in any way inferior, after having lost a character, through adaptation to changed conditions of life. The answer to this is: We do not call imperfection what we merely fancy such, but prove it to be imperfection, by the facts of close-interbreeding, which demonstrate, that physiological evils, viz., lessened fertility, and lessened constitutional vigor, are wrought upon the organism, in proportion, degree for degree, with such alleged imperfection.

With varieties, under domestication, this process of extinction, by means of the evils resulting from the interbreeding of forms wanting in characters of their species, is, with Pigeons, Fowls, and Pigs, hastened by Man, through his effecting the reduction of so many characters, in each variety, and through his altering the ratio of the development of the characters which remain. Such varieties cannot long survive, if they retain always their peculiarity of form. Darwin speaks of high fancy varieties of the Pigeon, being known, for hundreds of years; and, obviously desires it to be inferred, that such varieties may so long breed their kind. This they cannot do. Of these varieties, he himself says; that they "seem both to have origi-

nated and disappeared," and to have appeared again, "within this same period," of two hundred and odd years. He also refers to, and records the many breeds which "have become extinct" (p. 508, Vol. ii, *Animals and Plants, &c*).

The reason, that these fancy varieties continue their breed the length of time that they do, is, because, first, the differences, between the individuals of each variety, serve, in a measure, to stave off the evil effects for a time; secondly, because these varieties frequently cross; and, thirdly, because these varieties change their forms, from time to time, by means of the action of reversion in some of their characters, and of the influence of Man's Selection.

Darwin says (p. 262, Vol. ii, *Animals and Plants, &c.*):

"Fashions do, to a certain extent, change; first, one point of structure, and then another, is attended to." And again he says, "The fancy ebbs and flows."

This fashion and fancy are quite frequently controlled and directed, unconsciously to man, by the fact that health and breeding capacity are to be found, only in those individuals which depart in some point from the defective, varietal type. Man, therefore, in picking out the strong individuals and the good breeders, unwittingly changes the form of the variety.

With improved breeds of horses, of sheep, and of cattle, there is a probability of their being able to continue their line, for many centuries, because they generally approximate the full and proportionate development of their respective species.

CHAPTER IX.

The Crossing and the Close-Interbreeding of Pigs.

Of the smaller animals, the Pigeon, and the Fowl, as we have seen, show adaptation to man's use or fancy, at the greatest expense to their structural integrity. The results are, great disproportionate development and, as a necessary consequence of this, the greatest degree of the evils which are occasioned by close-interbreeding. In all of the larger animals, except the Pig, adaptation to man's use, has harmonized, to a greater or less degree, with the development, in each individual, of all the characters of its species.

With the Pig, as has just been remarked, it is otherwise. This species is the most disproportionately developed, of all the larger animals, under domestication. The disproportionate development, however, is due to a different occasion, from that which has entailed the abnormal structures of varieties of the Fowl, and of the Pigeon. In these species, under domestication, the false ratio of the development of their characters, is due, principally, to man's selecting, as the peculiarity of each variety, one only of the characters which were reduced or suppressed, under nature; and to his pushing the development of that character, to an extreme point. Thus, while all of the characters of the species,

Pigeon, for instance, are developed, under domestication, they are not all developed, in each individual; but, many of them are apportioned among different varieties.

With the Pig, however, there has been, under domestication, *direct* reduction and suppression of many of its characters. The same characters, have, in the main, been reduced or suppressed, in all of the improved (?) varieties of this species. Darwin, speaking of breeding in general, and of the divergence, which is so notably exemplified in the case of the pigeon, says (p. 290, Vol. ii, *Animals and Plants, &c.*):

"Selection, whether methodical or unconscious, always tending towards an extreme point, together with the neglect and slow extinction of the intermediate and less valued forms, is the key which unlocks the mystery how man has produced such wonderful results. In a few instances, selection, guided by utility, for a single purpose, has led to convergence of character. All the improved and different races of the Pig, as Nathusius has well shown, closely approach each other in character, in their shortened legs, and muzzles, their almost hairless, large, rounded bodies, and small tusks."

The only differences between the several breeds of Pigs, are the degrees to which this reduction and suppression has been carried; and the degrees in which those characters which have been retained, have been developed.

In all of the highly improved breeds, the legs, the tusks, the bristles, the hairy covering, the skin, the front of the head, the jaws, and the tail, have, as

has already been shown, been well-nigh eradicated, leaving them to serve as the merest appendages to a trunk, which, the more to vitiate the true ratio of the features of the species, has been monstrously developed.

It is manifest, then, that it is to the Pig, of all the larger animals, to which recourse should be had, for evidence of the theory, that the evil effects of interbreeding, are due to a departure from the mould, which comprises the full development of all the characters of the given species.

If there was ever a species, under domestication, with "serious defects in structure, or in the mutual relation of the parts," it is the Pig, as it presents itself, when "highly-bred."

Similarly: If there was ever a species, under domestication, which displayed marked evil effects from interbreeding, it is the Pig. To no other species, under man's care, does Darwin's remark, that, "Highly-bred animals are eminently liable to degeneration," so appropriately apply. For, it has been frequently remarked, by breeders, unconscious of the cause of the phenomenon they note, that the more improved the Pig, the more susceptible does it appear to be to the evils of lessened fertility, and delicacy of constitution.

Conformable to the presumption, raised by the great reduction in the characters of the Pig, is the following remark of Darwin:

"WITH PIGS," says he (p. 151, Vol. ii, *Animals and Plants, &c.*), "THERE IS MORE UNANIMITY *amongst breeders, on the evil effects of close-interbreeding, than, perhaps, with any other large animal.*"

The evil effects of interbreeding, in the case of the Pig, are a matter of general notoriety. In all of the discussions, on the subject of in-and-in breeding, no case meets with such continual mention. Those, who endeavor to gainsay the fact, that evil is generally attendant upon close-interbreeding, signally and miserably fail to invalidate the fact, that "well-bred" Pigs die out altogether, after having been bred in-and-in, for only a few generations. No one considers the fact, at all questionable; though a few verge close upon the truth, when they demur to the force of the circumstance; and allege that, somehow or other, man's treatment of the animals, has occasioned the evil effects. How the course of breeding, to which the Pigs are subjected, has to do with the phenomenon, they are at a loss to say.

The theory of proportionate development, discloses the mystery. The suppression of certain characters,—which, though of no direct use to the breeder, are yet of incalculable, physiological importance to the animal,—has been the aim and object, in the development of all the breeds. Being thus abnormally developed, physiological, evil effects result, as matters of course.

It is apparent, that the evils, of interbreeding, will never be corrected, whilst scientists prescribe to breeders, such a mode of selection, as the following:

"Again," says Darwin (p. 236, Vol. ii, *Animals and Plants, &c.*), "hear what an excellent judge of Pigs, says, 'The legs should be no longer, than just to prevent the animal's belly from trailing on the ground. The leg is the least profitable portion of the hog, and we therefore require no more of it, than is absolutely

necessary for the support of the rest.' Let any one compare the wild boar with any improved breed, and he will see how effectually the legs have been shortened."

Let any one compare, also, the fertility and strength of constitution, of the wild boar, or of any other pig which runs wild and has its several characters developed by exercise, or by correlation with organs which have been developed by exercise, with the little breeding capacity, and the weakness of any, so-called, improved breed, and he will see how effectually has the improved breed been punished for its departure from the true proportions of the original type.

Darwin says:

"Our wonderfully (!) improved Pigs could never have been formed, if they had been forced to search for their own food" (p. 283, Vol. ii, *Animals and Plants, &c*).

No; nor would they be so susceptible to the evil effects, which have been brought upon them, through outraging the proportion which is so necessary to physiological integrity. Had they been suffered to search for their own food, their legs would have grown to a size, proportionate to that of their body; and their hair, bristles, tail, head, tusks, and snout, would also have been adequately developed, through correlation with the legs.

But, as Darwin says (p. 492, Vol. ii):

"Man does not regard modifications in the more important organs * * as long as they are compatible with life. What does the breeder care about any slight change in the molar teeth of Pigs * * ?"

Man thus contemptuously intimates his indifference to the development of characters which do not subserve his purposes; yet, when grave evil waits upon such neglect, Man shuts his eyes to the clear connection between the two, and lulls his scientific instincts, by pompously referring the strange phenomena to a "great law of nature!"

That the cause assigned by the theory of Reversion, for the lessened fertility, and for the delicacy of constitution of Pigs, is a true one, is placed beyond all doubt, by the fact, before alluded to, viz., that, with those individuals of the species, under nature, and with those individuals of which little or no care is taken, there is very little evil entailed; and, that little is developed, only after many generations of the closest interbreeding. The reason lies in the circumstance, that, in the individuals under nature, and in those individuals which are little cared for, those characters are developed, which man either directly, or indirectly suppresses when he superintends the breeding of the animals. With Pigeons and Fowls, as has been seen, the farther, also, that man carries his care of the animals, the greater are the evils of close-interbreeding. But the cases are not exactly analogous. With Pigeons and Fowls, the reason why physiological degeneration attends the highly bred breeds, is generally because, in each such variety, the major portion of the characters become relatively reduced, by the exclusive development of the peculiarity, of the breed,—which peculiarity is ever being carried to an "extreme point." With the Pig, however, the reduction, in many of the characters, is not only relative

to the advanced, exclusive improvement of other characters, but is an absolute reduction. The more the trunk is developed, the further, absolutely, are the legs, tusks, hair, bristles, &c., reduced. Therefore, the greater the improvement, the greater the evils of close-interbreeding. For, the point is made, by breeders, to carry the reduction of the legs, tusks, hair, snout, &c., as far as is compatible with the continued existence of the animal.

Although the characters, mentioned as reduced, are reduced in all of the highly improved individuals and breeds, yet the very capacity to discriminate between the different breeds, and between different individuals of the same breed, shows, that the characters have not all been reduced in the same degrees. The reduction, in one character, has not, in one breed, or in one individual, been so great, as it has been in another breed, or other individual; and, where one individual, or breed, is much reduced in one character, and little reduced in another character, the converse may obtain, in other breeds, or in the other individuals. So, it is clear, that some gain, to offspring, in physiological integrity is possible, when two breeds, or distant individuals, are crossed.

Where individuals fail to breed, owing to their disproportionate development, the impotence is not absolute. Those very individuals will be quite prolific, when paired with individuals of dissimilar development. The reason is, a certain number and proportion of characters are required, in the parent, for reproduction. If an individual falls short of the required number and

proportion, it will be sterile, with others, of a like structure; because, from them, the characters wanting, obviously cannot be supplied. But, when such individual is bred with another, dissimilarly developed, he will be fertile; because this other has positive differences which go to make up, in the reproductive elements, the requisite number of characters required for any degree of fertility. Thus, it is clear, that two individuals of different breeds, each of which is perfectly sterile with others of its own breed, may be highly fertile with each other.

The keeping, of stock, at different localities, has been noticed, by Darwin, to have a tendency to eradicate the evils of interbreeding. The reason is, at different localities, there is different air, different food, there may be different occasions for exercise of the legs and of other parts; and the effect on the development of any one part, by means of such agencies, involves a certain degree of effect upon the development of other parts, by correlation. This is the mystery of the lessened evil effects, attendant upon the same degree of interbreeding, when the individuals have been kept at different stations. The mere difference, of the ground, in one yard, where fowls, or Pigs are kept, being undulating, to a degree, just perceptible to the eye; and of the ground, in the other yard, being of a dead level, would occasion some decrease in the evil effects of breeding two relations, kept at the different places. The little increase, in exercise, required by the nature of the ground, in the first instance, would strengthen different parts and muscles of the legs and feet; thence,

by correlation, the head, and all of its appendages, would be developed; and thence, also, by correlation, the hind portion of the body, and its appendages, would be favorably influenced.

Darwin's theory denies him all knowledge of these principles. The facts, however, which are inexplicable to him, and which most forcibly suggest such principles, he gives:

"Mr. Druce," he says (p. 151, Vol. ii, *Animals and Plants, &c.*), "a great and successful breeder of the Improved Oxfordshires (a crossed race), writes, 'without a change of boars, of a different tribe, but of the same breed, constitution cannot be preserved.' Mr. Fisher Hobbes, the raiser of the celebrated Improved Essex breed, divided his stock into three separate families, by which means he maintained the breed for more than twenty years (!) 'by judicious selection from the three distinct families.' Lord Western was the importer of a Neapolitan boar and sow. From this pair, he bred in-and-in, until the breed was in danger of becoming extinct, 'a sure result (as Mr. Sidney remarks) of in-and-in breeding.'"

These pigs, to which he refers, would not have withstood the interbreeding, which they did, before threatening to become extinct, had they been of the type of the well-bred (?) English pigs. They were Neapolitan pigs, and had not the characters of legs, &c., so much reduced, as the fashion, prevailing in England, requires.

Darwin continues:

"Lord Western then crossed his Neapolitan Pigs with the old Essex, and made the first great step towards the improved Essex breed. Here is a more interesting case. Mr. J. Wright, well known as a breeder,

crossed the same boar with the daughter, granddaughter, and great-granddaughter, and so on, for seven generations. The result was, that, in many instances, the offspring failed to breed; in others, they produced few that lived; and, of the latter, many were idiotic, without sense even to suck, and when attempting to move, could not walk straight. Now, it deserves especial notice, that the two best sows produced by this long course of interbreeding, were sent to other boars, and they bore several litters of healthy pigs. The best sow, in external appearance, produced during the whole seven generations, was one in the last stage of descent; but the litter consisted of this one sow. She would not breed to her sire; yet bred, at the first trial, to a stranger in blood, so that, in Mr. Wright's case, long-continued and extremely close-interbreeding did not affect the general form or merit of the young; but, with many of these, the general constitution, and mental powers, and especially the reproductive functions, were seriously affected."

With respect to this last remark of his, it may be asked: How is it possible, in his eyes, for close-interbreeding to affect, unfavorably, the general form of the young, when the very degeneration in form, which is occasioned by interbreeding, is what he, and other breeders of Pigs, esteem an improvement? Interbreeding intensifies any evil in parts. So, when a well-bred Pig has its legs, tusks, &c., further reduced by such a process, Darwin looks upon such an effect, as an improvement which but enhances the value of the animal. The same simple remark he makes, when speaking of Pigeons. As before noticed, he, with charming simplicity, notes that the evil effects produced upon the form, is far more noticeable in the case

of long-beaked Tumblers, than it is with short-beaked Carriers. Of course it is; for, the aim of the breeder, with the Tumblers, is to reduce the beak; and, when this purpose is subserved by interbreeding, the breeder, of course, cannot see, that any evil is produced.

To show, that these "innate-tendency"-and-"great-law-of-nature" breeders and philosophers actually fancy, that they may, *ad lib.*, normally mould the form of an animal, as clay in the hands of the potter, the following suffices (page 236, Vol. ii, *Animals and Plants, &c.*):

"The eye has its fashion at different periods; at one time the eye high and outstanding from the head, and at another the sleepy eye sunk into the head."

The sleepy eye, sunk into the head, is both a structural, and a physiological defect. When, then, interbreeding were to intensify such defect, Darwin would naively note, that he could not see that interbreeding injuriously affected the form of the animal. The question, in all such cases of evil effect upon the form, is, with Darwin, resolved into the inquiry, What is the fashion?

When a sow has not been bred in the strictest conformity to the English standard for the porcine form,—which demands the greatest reduction, of all the characters (save the fat), that is consistent with the Pig's existence,—it is possible for such sow to reproduce a Pig. But, it is rather hard to expect the sow,—when a lump of fat only, has left the impress of its force, upon her reproductive element,—to effect such a differentiation of parts, as is required for the formation of

offspring. "Bricks without straw," were a facile operation, by comparison. It is, without doubt, true, that, were the sow as well disciplined in habits of thought, as have been those of her brethren who have "trod the boards;" and, were she to devote her accomplishments to the study of Herbert Spencer's "First Principle," she might (were no aberration of her cerebral or reproductive system, to follow therefrom) learn the trick (even were she the mould of form so dear to an English pork-breeder's heart) of how to evolve, by a necessary law, a homogeneity of fat, into that heterogeneity of adipose tissue, yclept a Pig. Herbert Spencer is immeasurably more astute than is Darwin, in his exposition of the processes of evolution. When improvements occur, Darwin, with a simplicity, born of little knowledge of the cavils in which some people unkindly indulge, ascribes them to "innate tendency," to "spontaneous variability;" a course, which at once discloses, that such terms are but the counters for ignorance. Not so Herbert Spencer. Herbert Spencer explains the improvements, by referring them to a law which lies on the uttermost verge of the domain of the Knowable; which he terms "the instability of the homogeneous," by which a "differentiation" ever results, from "a state of homogeneity," into "a state of heterogeneity." The beauty of this explanation lies in the circumstance, that his disciples, by the time that they have acquired a faint glimmering of the meaning of his terms, are so completely exhausted, that they have not even a grain of cerebral phosphorus left, with which to gauge the

utility of information, so happily conveyed. If Englishmen valued their reputation among posterity, they would make a holocaust of Spencer's works; for, to have such a tissue of charlatanry represent, as it is said to do, the highest phase of English thought, is the most disgraceful commentary upon the intellectual life of a nation, ever recorded in history. By this, it is not meant to intimate that the intellect of Spencer, is on a level with his works. To insinuate anything of the kind, would be as unfair, as it would be to estimate the understanding of a politician, from the impolitic and inane measures which party exigencies, and ambition for preferment, had counseled him to advocate. Herbert Spencer has merely availed himself of the prevailing mode of thought, and of the intellectual weaknesses of the English people, to insure his personal fame. No man could play so deftly upon the prejudices of the heterodox, and make them digest such absurdities as he has propounded; and not be a man of an order of intellect, somewhat above the average. It seems, even, here and there throughout his works, that he has, in a vein of cynical humor, endeavored to see how far he might carry an experiment, upon English credulity, without detection. A case in point, is where he animadverts, in the most unmeasured terms, against the illegitimate and unphilosophical mode of referring any phenomena to "innate tendencies," or other "metaphysical entities;" whereas, his whole system is built upon such proscribed references; and these "metaphysical entities" do yeoman's duty, upon well-nigh every page of his works. His principal cue,

in the elaboration of his synthesis, seems to have been, that man, however heterodox he may be, is not,—cannot be,—content with disbelief alone; he needs a complimentary belief, and is ever ready to believe anything and everything (however absurd) which harmonizes with his disbelief. Very, very few have ever read Spencer's works; yet every man of "liberal" ideas, swears by them.

To return to the sow: Darwin says (p. 151, Vol. ii, *Animals and Plants, &c.*):

"Nathusius gives an analagous, and even more striking case; he imported, from England, a pregnant sow, of the large Yorkshire breed, and bred the product closely in-and-in, for three generations; the result was unfavorable, as the young were weak in constitution, with impaired fertility. One of the latest sows, which he esteemed a good animal, produced, when paired with her own uncle (who was known to be productive with sows of other breeds), a litter of six, and a second time, a litter of only five weak, young pigs. He then paired this sow with a boar of a small, black breed, which he had likewise imported, and which boar, when matched with sows of his own breed, produced from seven to nine young; now, the sow, of the large breed, which was so unproductive when paired with her own uncle, yielded to the small black boar, in the first litter, twenty-one, and in the second litter, eighteen young pigs; so that, in one year, she produced thirty-nine fine, young animals."

The reason was: from the boar, of her own kind, she received a male, sexual element, impressed with the force of the few characters only, which she herself had; while, from the strange boar, which most probably

differed positively, from her, in several characters, she received an element which augmented the power of reproduction, by adding, to what she gave to the formation of the offspring, the force of characters which she had not.

The effects of interbreeding, upon the fertility of Pigs, must not be estimated by the amount of fertility in this animal, as compared with the amount of fertility, in other species. The evil effects are to be estimated, by comparison only, with the maximum amount of fertility, for the given species. Thus, even when the disproportionate development of a Pig, causes the fertility of such animal to fall far short of the maximum fertility of its species, it is more fertile than (say) an elephant which is perfect in the integrity of its species. So, the injury to the physiological integrity, would be erroneously estimated, were not the criterion of perfection, to be the full measure of productiveness, within the same species. Thus, the Pig may have twenty, or thirty offspring, at a birth, and another species have but two. In the one species, therefore, the circumstance of having two at a birth, might consist with perfection, in the animals; whereas, the fact of having only a dozen, at a birth, would, with the Pig, imply disproportionate development. A similar caution obtains, in estimating the degree of advance towards perfection, by the number of characters regained. It is not absolutely, the number, of characters, which is necessary to physiological integrity. It is the full number of the characters, proper to the given species. As before remarked, the tiniest insect which

flies, if possessed of all the characters of its species, is, to the full, as perfect, physiologically, as the elephant, which is of such complex development.

The principle before referred to, respecting the impossibility of an ill-proportioned breed, long continuing its existence, without crossing, or otherwise changing its form, is strikingly displayed in the case of the Pig, whose breeds are, under domestication, all ill-proportioned. To ward off the extinction of the highly-bred breeds of Pigs, crossing has to be resorted to, all the time. In one of the quotations, above given, it is seen that Darwin deems it worthy of note, that a Mr. Fisher Hobbes, by means of "judicious selection," and by "dividing his stock into three separate families," "maintained the breed for more than twenty (!) years."

In this connection, Darwin says (p. 240, Vol. ii, *Animals and Plants, &c.*):

"Our Pigs, as Mr. Carrington remarks, during the last twenty years, have undergone, through rigorous selection, together with crossing, a complete metamorphosis!"

And again, in noting the many breeds, of all species, which "have become extinct," he says: * * *

"At the present time, improved breeds sometimes displace, at an extraordinarily rapid rate, older breeds; as has recently occurred throughout England, with Pigs."

All of the present, cultivated breeds of Pigs, have been produced by crossing. When crossed, the animals start off with a stock of characters, derived from the two old breeds; which enables them to run for awhile,

before sterility and completely shattered constitutions, are threatened. When these effects occur, the animal is required again to be crossed, to preserve it; and that tolls the knell of the old breeds, and rings in the advent of a new breed. When the individuals of this new breed, become, by interbreeding, of a dead uniformity of character, they must repeat the same process, and their breed undergo a complete metamorphosis. Were the characters, which are reduced in these breeds, all developed, the breeds might run their course, for centuries, without being driven to a cross. Or, did breeders give the legs a little show, they would not be forced to the unpleasant necessity of so frequently crossing their choice breeds.

Darwin says (page 120, Vol. ii, *Animals and Plants, &c.*):

"The improved Essex Pig owes its excellence to repeated crosses with the Neapolitan, together, probably, with some infusion of Chinese blood."

The advantage of crossing with the Neapolitan, and with Chinese breeds, is due to the fact, that the Neapolitan and Chinese standards do not require the reduction of so many characters, as does the English standard of Pig breeding.

"With most of the improved races of the Pig," says Darwin (p. 120, Vol. ii, *Animals and Plants, &c.*), "there have been repeated crosses."

He says, that, owing to the great delicacy of constitution, and to the sterility entailed upon highly-bred animals, a great amount of crossing has been found necessary, to keep the breeds from extinction.

"Chiefly in consequence of so much crossing" (p. 101, Vol. i, *Animals and Plants, &c.*), "some well known breeds have undergone rapid changes; thus, according to Nathusius, the Berkshire breed of 1780, is quite different from that of 1810; and, since this latter period, at least two distinct forms have borne the same name."

CHAPTER X.

The Crossing and Close-Interbreeding of Horses, Sheep and Cattle.

It has been shown, that, with Fowls and Pigeons, the multiplicity of divergent varieties, observable in either of these species, involves great disproportionate development of the individual; and, comformably to the theory adduced in this work, it has been found, by reference to the phenomena recorded by Darwin, that such individuals are peculiarly susceptible to the evils occasioned by interbreeding.

With the Pig, although there is no or very little divergence of character, a failure in proportion of the characters, has been caused, by a process of degeneration, persisted in by Man, through a very mistaken sense of policy. It has, likewise, been shown by Darwin's facts, that very great evil results from the reduction of the characters of the Pig.

It is now designed to show, that with those species, under domestication, whose individuals approximate the true type of their respective species, there is an almost complete exemption from the evils of lessened fertility, and of lessened constitutional vigor, however long and closely, the individuals may be interbred. It must be remembered, that it is not necessary to show

a total absence of evil; for, even individuals of the same family, differ, in some degree, from each other; and, that necessarily implies, that all but one of the individuals, are measurably degenerate.

The true ratio of the development of the characters of a species, or due coördination, is realized more in the Horse, in the Cow, and in the Sheep, than in any other animals upon which man has bestowed any degree of care. Though the individuals, of each of these species, may lack one or more of the characters of their respective species, and may vary, to some extent, the just relation of their parts; they are, comparatively, proportionately developed. With them, there is no such division of features, among the different varieties, as is met with, in the case of the Pigeon and of the Fowl. Neither, is there such a reduction and suppression of parts, as are observed in the Pig.

With Cattle, with Sheep, and with Horses, all of the characters, of the respective species, are retained, in each of the varieties. True it is, especial care may be given, in each of several varieties, to some one excellence; and, the true proportion may be thus, in some degree, affected; yet, such proportion is not much altered, because, together with the special feature, the other parts are suffered to develop themselves:—to which development accidental circumstances often contribute, such as the exercise which the animals are permitted, and the degree of self-feeding, to which they are accustomed. This concurrent bringing-up of all the characters, in each individual, has precluded that divergence of character, which is so observable, in Pigeons

and Fowls, and, which is so prolific of evil, by reason of its entailing, in each individual or variety, the absence of the important, positive peculiarities of others of the same species.

The fact, of individuals of each of the Horse, Sheep, and Cow species, falling thus so little short of the original type of their respective species, leads to the expectation, that little, or no evil is the outcome of their interbreeding. This expectation, with respect to Cattle, and to Sheep, is amply fulfilled by Darwin's facts.

With respect to the Horse, it may be said, that it is, manifestly, of all animals, the most proportionately developed. Race-horses, and dray-horses, are very distinct; but very distinct, only, for breeds of Horses. What constitutes a great difference, between breeds of Horses, is, compared with the differences between breeds of other species, a very slight distinction. In the Horse, all or nearly all of the characters maintain the true relation. The theory of reversion, then, requires, that the facts should show the possibility of the highly-bred animals, of this species, being long and closely interbred, with impunity. It would be an occasion of surprise, if the horse was not a most striking instance, of exemption from the injurious results of this process.

Yet, strange to relate, there is, notwithstanding the fact that the evidence, obtainable upon this subject, is both most abundant and widespread, a remarkable absence, in Darwin's works, of all mention of the experience of breeders, respecting the crossing and the

interbreeding of Horses. Could it have been,—what there is so much throughout his books, to warrant one in suspecting,—that Darwin guessed the true secret of the in-and-in breeding process, and feared lest, if he noted the Horse's exemption from the evil results, the current conception of symmetry, which attaches, peculiarly, to the Horse, would evoke the truth, namely, that the proportionate development of the characters of a species, is the *sine qua non* of perfect physiological condition?

The stipulation, with which we started,—viz., that both the Refutation and the Converse Theory, would be based exclusively upon Darwin's facts,—precludes any detailed reference to the evidence, showing how the Horse does withstand in-and-in breeding. It is a matter of such common notoriety, however, that, possibly, any such evidence which Darwin might have furnished, would be esteemed by the reader, as needless, furnished as the reader now has been with the light afforded by the idea of Reversion.

With respect to Cattle, and to Sheep, Darwin says (p. 146, Vol. ii, *Animals and Plants, &c.*):

"WITH CATTLE, THERE CAN BE NO DOUBT, THAT EXTREMELY CLOSE-INTERBREEDING MAY BE LONG CARRIED ON; *advantageously, with respect to external characters, and with no manifestly apparent evil, as far as constitution is concerned.* THE SAME REMARK IS APPLICABLE TO SHEEP.

"Whether these animals have gradually been rendered less susceptible, than others, to this evil, in order to permit them to live in herds,—a habit which leads the old and vigorous leaders to expel all intruders,

and, in consequence, often to pair with their own daughters, I will not pretend to decide." (!)

How coolly, Design is here invoked, to extricate this brilliant disciple of Bacon, from the quandary he is now in. When our heterodox friends fancy, that some secondary law which they have discovered, or some apology therefor, which they have deftly devised, contravenes the doctrine of Final Causes, they take care to acquaint the world, in tones of dignified severity, that they esteem such doctrine, a monster of most frightful mien, born of the distempered imaginations of the superstitious; but, when this principle,—so much abused in the houses, both of its friends and of its foes,—will alone, they conceive, subserve the purpose of patching up their ragged, and flimsy theories, with what charming suavity, they court and embrace it! We believe in the doctrine,—not in such an application, as is above made of it however;— but, we do not deem ourselves bound therefore to believe every absurdity which is adduced in evidence thereof. It is ignorance alone, which holds itself constrained to fall back upon the doctrine of Final Causes. There is, never, need to invoke the doctrine, to solve any difficulty. For, wherever its operation, in any instance, may be definitively settled; there are always secondary laws which wholly preclude the necessity of any reference to it. Where such secondary laws are not positively known to subserve it,—however proper it may be to admit it as an element of moral evidence,—it has no title to admission within the domain of positive science. So, in either contingency,

it has no concern to be mixed up in scientific controversies.

Darwin's beautiful tribute to the efficacy of Divine Government, will avail him, or his theory, not a jot, in the presence of the facts. It is to be lamented, that, when Darwin does essay a little orthodoxy, it should be so palpably misdirected. The simple solution, of the phenomenon to which he refers, is, that, for whatever disproportion resides in any individual, that individual must pay the penalty, in the evils, usually incident to close-interbreeding: But, as with Cattle, the violation of structural symmetry, has been little, the physiological penalty is correspondingly small. Could an explanation be more satisfying? or, could any assigned cause be more readily and easily adjustable to actual and possible variations in the quantity of the effects?

Continuing, Darwin says:

"The case of Bakewell's Longhorns, which were closely interbred for a long period, has often been quoted; yet, Youatt says, the 'breed had acquired a delicacy of constitution, inconsistent with common management,' and 'the propagation of the species was not always certain.' But, the Shorthorns offer the most striking case of close-interbreeding: for instance, the famous bull, Favorite (who was himself, the offspring of a half-brother and sister from Foljambe), was matched with his own daughter, granddaughter, and great-granddaughter; so that the produce of this last union, or the great-great-granddaughter had fifteen-sixteenths or 93.75 per cent. of the blood of Favorite in her veins. This cow was matched with the bull Wellington, having 62.5 per cent. of Favorite blood

in his veins, and produced Clarissa: Clarissa was matched with the bull Lancaster, having 68.75 per cent. of the same blood, and she yielded valuable offspring. Nevertheless, Collings, who reared these animals, and was a strong advocate for close-interbreeding, once crossed his stock with a Galloway, and the cows from the cross realized the highest prices."

These animals approached very close to the perfect form of their species. They needed, perhaps, little more than a greater development of their horns (which were short), to enable them to withstand, forever, the closest interbreeding. With respect to the Longhorns; the reason, that evil results began eventually to tell upon them, was due, perhaps, to their horns being pushed to a development, far out of proportion to the size of their other characters (which is a defect as serious, as where the error lies in the other direction, viz.: of inordinate decrease in size of such a feature); and, due to other defects in proportion. The absence, in an animal, of the many slight, positive differences which characterize others of the same breed, and of other breeds, occasions defects which a long continued course of in-and-in breeding will cause to tell palpably upon the organization. Even, when the true theory of development is accepted, as a standard, an individual may be esteemed the very ideal of proportionate development, yet, when a minute comparison is made of the animal, with others of its species, it will be discovered, in how many little points, here and there, improvement remains to be effected.

For, as Darwin says (p. 10, Vol. 2, *Animals and Plants, &c.*):

"Probably, no two individuals are identically the same:" no two "are of a face:" "the shepherd knows each sheep, and man can distinguish a fellow-man, out millions, upon millions, of other men:" and "Shepherds have won wagers, by recognizing each sheep, in a flock of a hundred, which they had never seen, until the previous fortnight."

Now, this power of discrimination,—based as it is, upon the conscious, or unconscious perception of features, peculiar to the individuals so distinguished,—generally implies, that there are many positive points of structure, which even a seemingly perfect and symmetrical individual must lack. Many, therefore, of these little features,—just recognizable by a practiced eye,—when added up, make a sum of defects, which is calculated to tell, after many generations of close-interbreeding.

In a cow, for instance, in which it would be difficult to see, wherein the animal was in any wise deficient, there may yet be some slight detail of proportion, wanting, in every one of the following characters: in the horns, in the legs, in the hoofs, in the ears, in the eyes, in the tail, in the nostrils, in the muzzle, in the coating of hair, in the neck, in the chest, in the ribs (defected slightly, for instance, from the true curve, or arch), in the shoulder, in the rump, in the vertebræ, and in numberless other characters, both internal, and external.

When two individuals, which are similarly defective in these almost infinitesimal points, are matched, they will not be susceptible, to any appreciable degree, of evil; but will, for many generations, rather, go on im-

proving. But, after (say) twenty, or thirty generations of interbreeding, between (say) brothers and sisters, the evil will begin to manifest itself; unless, the capacity for reversion, in these slightly deteriorated parts, has been able to outstrip the exacerbation, consequent upon the community of defects, in the individuals paired; or unless the brothers and sisters were dissimilar in these little points,—which would not be unlikely.

When regarded by themselves, it is apparent, from what is known of the diversity prevailing among the different breeds of cattle, that the individuals vary much from what can be estimated to be the true ratio of the development of the characters of the said species. But, such departure from the true type, implied from their diversity, seems scarce worthy of thought, when the great disproportion of Pigs, Pigeons, and Fowls (especially of the high fancy breeds thereof), recurs to the mind.

Again Darwin says, respecting Cattle:

"Mr. Bates's herd was esteemed the most celebrated in the world. For thirteen years, he bred most closely in-and-in; but, during the next seventeen years, though he had the most exalted notion of the value of his own stock, he thrice infused fresh blood into his herd; it is said, that he did this, not to improve the form of his animals, but on account of their lessened fertility. Mr. Bates's own view, as given by a celebrated breeder, was that 'to breed in-and-in from a bad stock, was ruin and devastation; yet, that the practice may be safely followed, within certain limits, when the parents, so related, are descended from first-

rate animals.' We thus see that there has been extremely close-interbreeding with Shorthorns; but Nathusius, after the most careful study of their pedigrees, says that he can find no instance of a breeder, who has strictly followed this practice, during his whole life. From this study, and his own experience, he concludes that close-interbreeding is necessary to ennoble the stock; but that, in effecting this, the greatest care is necessary on account of the tendency to infertility and weakness."

Had the defect, which the name, Shorthorns, connotes, been supplied, the animals just mentioned, could go on interbreeding, for double, treble the time; aye, forever, were there no positive differences, possessed by other cattle,—thereby implying that, in some details, the former were deficient. The evil, of the shortened horns, is indirectly, but surely shown, by the following remark of Darwin:

"It may be added" (p. 174, Vol. ii, *Animals and Plants, &c.*), "that another high authority asserts, that many more calves are born cripples, from Shorthorns, than from any other and less closely interbred races of Cattle."

This effect is due, to the fact, that the horns and the legs are correlated, in all animals; and, therefore, when one, of two parts which are so tied or correlated together, is absent or reduced, the other is, in some degree, weakened. This injury to the balance of the organization, is, of course, augmented by the mating of two individuals in which the said defects similarly obtain; and, this is the reason of the strange phenomenon which Darwin notes.

With respect to the interbreeding of *Sheep*, Darwin says:

"WITH SHEEP, THERE HAS OFTEN BEEN LONG-CONTINUED INTERBREEDING WITHIN THE LIMITS OF THE SAME FLOCK; but, whether the nearest relatives have been matched so frequently, as in the case of Shorthorn Cattle, I do not know. *The Messrs. Brown, during fifty years, have never infused fresh blood into their excellent flock of Leicesters.* Since 1810, Mr. Barford has acted on the same principle, with the Foscote flock. He asserts, that one half a century of experience, has convinced him, that when two nearly related animals are quite sound in constitution, in-and-in breeding does not induce degeneracy; but, he adds, that he 'does not pride himself on breeding from the nearest affinities.' *In France, the Naz flock has been bred, for sixty years, without the introduction of a single, strange ram.* Nevertheless, most great breeders of sheep have protested against close-interbreeding prolonged for too great length of time. The most celebrated of recent breeders, Jonas Webb, kept five separate families to work on, thus retaining the requisite distance of relationship between the sexes."

And, then continuing, Darwin says, that:

"By the aid of careful selection, *the near interbreeding of Sheep may be long continued, without any manifest evil.*"

It is a noteworthy fact, that all of the breeders, quoted by Darwin, unlike Darwin, seem to have hewn their opinions, close to the line of the facts. They formulate no "great law of nature!" Darwin doubtless calls it a "*law*," upon the *lucus a non lucendo* principle;—because it governs nothing.

It may be thought strange, that Darwin, who so

economizes facts which are "ugly" in the aspect they wear towards his theory, should have adduced these phenomena, respecting Cattle and Sheep, which militate so strongly against his "law."

There is one explanation, which needs not any conjecture, to establish its soundness. It is,—that he is bent upon showing, that the whole subject of fertility is so completely "muddled," that it is unfair to draw any inference, against his theory, from the sterility of hybrids. As before intimated, it shall be demonstrated how little such an ingenious device avails him. Another reason, which may explain why he adduces the evidence of the exemption, of these proportionately developed animals, from the evils of interbreeding, is, that he doubtless deems the strength and validity of his "law," in question and in doubt, until he shows exceptions to its operation;—upon the principle, that "the exceptions prove the rule." If such be the case, his readers have a perfect Bonanza of assurance upon that point.

On page 175, Vol. ii, *Animals and Plants, &c.*, he again reiterates his "great law of nature," and adds:

"*The rule applies to all animals*, EVEN TO CATTLE AND SHEEP, WHICH CAN LONG RESIST BREEDING IN-AND-IN BETWEEN THE NEAREST BLOOD RELATIONS."

The fact, of his here being necessitated to note, that the rule applies "even to Cattle and Sheep," is not without its significance.

Again he says (p. 213, Vol, ii, *Animals and Plants, &c.*), referring to Cattle and Sheep, and, doubtless, to

those individuals of each species, which have all the characters of their species, well developed:

"With some animals, close-interbreeding may be carried on, for a long period, with impunity, by the selection of the most vigorous and healthy individuals; but, sooner or later, evil follows."

The questions, however, for Darwin to answer, are, Why sooner? and, Why later?

The experience of breeders shows unequivocally, that extremely long-continued, close-interbreeding is possible with Cattle and Sheep. This is an occasion of no surprise, when it is remarked, how proportionately developed these animals are, in comparison with other species.

The testimony also acquaints us with the fact, that, although this process may be long carried on, evil at length begins to manifest itself. Nor, is there room for marvel, in this connection. For, although all of the characters of each species, have a passably fair chance to become developed, there is always some one character, in each breed, to the development of which the breeder devotes especial care. Besides this, some defects in the true proportion, are frequently occasioned by blind conformity to certain standards existing in the breeder's mind; or, to a certain standard prescribed by fashion; or, defects are present, through breeders having deemed it politic to continue a certain, defective arrangement, of characters, which originally and accidentally accompanied the special excellence of the breed, as the preservation intact of the build as originally discovered (inclusive of such defects), would

be deemed a guaranty of purity of blood. They are moved to this, frequently, by the fancy that, in some mysterious way, the special excellence is dependent upon such peculiar build. To preserve this peculiar ratio of the characters, the breeder is forced to interbreed the individuals, and, of course, after a time, short or long, according as the proportion has been impaired, the consequent evil becomes manifest.

It is apparent, that, when it is an object with each breeder, to preserve the type of his breed, there is little attempt to remedy any defects in structure.

As Darwin remarks (page 195, Vol. i, *Animals and Plants, &c.*):

"Any visible deviation of character, in a well-established breed, is rejected as a blemish."

Is it any wonder, that evil effects do eventually result, when, not only are many little points of structure left to continue defective, but, when the point aimed at, by breeders, is to bring all of the animals, of a breed, which are to be interbred, to a dead uniformity of character, which is replete with defects?

"Youatt urges the necessity," says Darwin (p. 236, Vol. ii, *Animals and Plants, &c.*), "of annually drafting each flock (of sheep); as many animals will certainly degenerate, 'from the standard of excellence which the breeder has established in his own mind.'"

Breeders, in pursuance of this course of preserving what they have seen fit to regard as the proper type, for any variety, even discard, and "weed" out (as they say), many *positive* points of structure, which are sorely needed, to fill out the proportion.

As before marked, the undue development of the special excellence of a variety, is the principal element, in the evils which ultimately manifest themselves. Where the horns are the peculiarity of a breed, they are pushed to a development, out of all proportion. The extreme development of the udders, and mammary glands, in many breeds, is not without its deleterious effect. It will be, doubtless, fully understood, that this extreme development, referred to, is not an absolute evil; but an evil, only relatively to the lesser development of the other characters. Then, the immense coats of wool, which many small sheep are forced to produce, mar the proportion.

Darwin says (page 239, Vol. ii, *Animals and Plants, &c.*):

"Sheep are bred and valued, almost exclusively for the fineness of the wool."

It remains a question, to be settled by future experiments in close-interbreeding, whether coarseness is not the normal condition of the wool. If so (which is probable), the quality of wool, produced for Man's benefit contributes its quota to the evil.

Of course, it would never do, for Man to forego the production of fine wool, in order to perfect the physiological integrity of the Sheep. Nor, would there be any adequate occasion; for, the effect of reduction, in size, of the threads of wool, would not manifest itself,—if all other characters of the sheep were fully and proportionately developed,—until after fifty generations, perhaps, of the closest possible interbreeding.

The fault to be found with Man's processes of breed-

ing, is not, that he subordinates the health and fertility of the animal or plant, to the special object in view; but that he ignorantly reduces and suppresses parts, in the organisms, and suffers them to remain reduced or suppressed, when no purpose of his is to be subserved thereby; and, when the ends he aims at, are thereby eventually defeated, and toil and trouble occasioned him, by the lessened fertility, the sterility, and delicacy of constitution which, after all he has done to provoke them, appear so mysterious to him. The same remark is applicable to the extreme development of the udders, in cattle: Let man but see that points in the structure of the animals, are developed, which it is now a matter of indifference to breeders, whether they are developed or not; and he will find no material obstacle in the effect on the fertility and vigor, produced by such undue development of the udders. Not only does Man, in his breeding of Cattle and of Sheep, produce the evil results of close interbreeding, by carrying a special excellence to excess, and by continuing the false proportion, of characters, which existed when such special excellence was assigned as the peculiarity of a breed; but he also, from misguided policy, reduces some characters which, he fancies, are in no wise profitable to him. How far profitable, they may be, to the animal, he never stops to consider. He considers a little, when the results of interbreeding occur to vex him; but, so blinded is he, and so imbued with the idea, that all organisms were assigned to his care, to mould, as he lists, that this element,—the reduction of which he has effected,—never enters into

any conjecture he may make as to the cause of the evil.

Not only are characters directly reduced by the breeder; but other characters, also, are degenerated, either, owing to the adverse conditions in which the animals are placed, or owing to correlation with features which, from any cause, do not attain to proportionate development.

An example of this, is given by Darwin, in the following remark (page 361, Vol. ii, *Animals and Plants, &c.*):

"With respect to Cattle, Professor Tanner has remarked, that the lungs and liver in the improved breeds, 'are found to be considerably reduced in size, when compared with those possessed by animals having perfect liberty;' and the reduction of these organs affects the general shape of the body. The cause of the reduced lungs, in highly-bred animals which take little exercise, is obvious; and, perhaps, the liver may be affected by the nutritious and artificial food on which they largely subsist."

It is likely, also, that the reduced size of the liver may be due, either to direct correlation with the comparatively little exercised legs, or to correlation with the head and its several appendages, which are, themselves, immediately correlated with the legs.

Of the reduction of characters, by Man, the Pig affords the most notable instance. With the Sheep, however, it has been deemed, in some instances, desirable to make the bones of the leg, as thin as possible; such being considered a "*saving!*" The legs have also been divested, as far as possible, of any woolly

covering; and the flesh thereon, it has been a point, to reduce to a minimum. The animals are even placed upon a table, as mentioned below by Darwin; and, it is thus ascertained, how far a "saving" may be had, in the internal organs; and, how far the fat (which is tissue which has undergone a retrograde metamorphosis) may be extended. These things ascertained; the relatives of those animals esteemed worthy of commendation, are interbred; and (some of), the results desired, thereby attained—and some, results, too, which are not desired.

Darwin says (p. 33, *Origin of Species*):

"Sheep are placed on a table, and are studied, like a picture by a connoisseur; this is done three times, at intervals of months, and the sheep are each time marked and classed, so that the very best may ultimately be selected for breeding."

Even Darwin sees that the reduction of characters is injurious; but he does not extend the induction,—doubtless, because he perceived that, if he did, his "great law of nature" would lose in dignity, by thus becoming less mysterious and inscrutable.

"Youatt believes," says he (p. 293, Vol. ii, *Animals and Plants, &c.*), "that the reduction of bone, in some of our Sheep, has already been carried so far that it entails great delicacy of constitution."

The reason, for instance, that Merinoes have a tendency to barrenness, is because, among other defects, their legs are small in the bone, their breasts and backs are narrow, and their sides are somewhat flat; and because their foreheads are low, and there is under

the throat, a singular looseness of skin, or hollowness in the neck. Everything is sacrificed to fineness and quantity of wool, in them. This is the criterion; and, however deformed, or miserable the carcase is, it always passes muster, if the special excellence be superior, or up to the average of the breed. The consequence is, invariably, the eventual ruin of the animals, which die out, unless crossing is resorted to; which replenishes the organic stock, and saves the individuals from sterility and extinction. The proportion of the carcase, is not even a secondary consideration, with breeders; the most radical defects, in structure, being often relied on, as assuring the purity of the breed.

Bakewell, of Leicestershire, in the middle of the last century, seems to have been the only breeder who ever had a glimmering of the correct principle of breeding. His aim was, to procure the proportionate development of all the characters, in his Sheep. The effects of this policy, are observable to the present day, in the descendants of his breed. It is they, to which Darwin refers, as being the animals which are exceptionally exempt from the evils of long-continued, close-interbreeding! Darwin also remarks, respecting them (p. 236, Vol. ii, *Animals and Plants, &c.*):

"Lord Somerville, in speaking of the marvelous improvement of the New Leicester Sheep, effected by Bakewell, and his successors, says, 'It would seem, as if they had just drawn a perfect form, and then given it life.'"

Yet, breeders, whilst admiring the perfection of form, and the almost complete exemption from evil, attend-

ant thereon, will go on breeding animals, and make no attempt to repair such defects, as legs reduced in size, and in bone, and void of wool; a head hornless, small, concave or too abruptly tapering; body either diminished in width, towards the rump, or, with chest and barrel narrow and shallow; the ribs, forming but a meagre arch from the spine; the back, hollow; the ears, small; the withers, depressed; the tail, short and small; and other variations from the true symmetry of build.

Blackwell made, what must be considered, in theory, as a mistake; although, practically, it was not such. Reference is had, to the small size at which he aimed, in all his animals. He was governed, in this, by perceiving, that smaller animals are of more profit to the breeder, because they consume less food, as the same amount of pasture, which feeds a smaller number of large animals, will suffice a larger number of small ones.

Upon even the strictest, practical principles of breeding, he was justified, in this course. For, if the proportion of the characters be maintained, it matters but little, within certain limits, how the general size may be reduced; and, as the very little evil entailed by mere reduction in size, would be made manifest, only after many generations of the closest interbreeding, the gain, resulting to the breeder, would more than outweigh any consideration of the slight and remote injury to the animals.

That some evil, though, generally, inappreciably small, does result from reduced size, is manifest, *a*

posteriori, by actual observation; and *a priori*, from the loss of interstitial tissue, necessarily involved; from the fact, that many organs must be measurably impaired, in function, when their size is reduced; and, from the fact, that, when dissimilarly developed animals, of a species, are crossed, increase in size results, and when disproportionately developed animals are interbred, decrease in size is occasioned. The small size of many Horses (Ponies, &c.), is due to their close interbreeding, which was incompetent, by reason of the animals' little disproportion, to work much loss of fertility, or of constitutional vigor; but, which elicited the evil of disproportion, chiefly by means of reduction in size. This view is confirmed by the fact, that, when a small number of animals, much disproportionately developed, are restricted within a narrow range, such as an island, or a valley enclosed by impassable mountains, thus necessitating their interbreeding, the animals die out; but, when animals but little disproportionately developed (such as Horses), are so confined, and constrained to interbreed, they do not so die out, but become, instead, much reduced in size,—the reduction being caused by the little disproportion which is insufficient much to affect their fertility and vigor. Jersey and Alderney breeds are also instances of the operation of this principle.

They are too little disproportionately developed to have entailed upon them the evils of much lessened fertility and of much lessened constitutional vigor, from interbreeding not very close; but the defects in structure which they have, entail, instead, reduction in size.

If an organism has all of its features, proportionately reduced, the evil entailed, will be less, than if some only of its characters are reduced; for, the balance is, in the former case, immeasurably less disturbed. But, even when the proportion is preserved as well as may be, in the reduction of the animal's size, evil results, because perfect proportion is incompatible with any reduction; for, the tissue which filled the interstitial spaces, is wanting, and full functional play of the several organs of the body, is inconsistent with any reduction. The evil effects, entailed by a measurably proportionate reduction of all the characters, are inappreciable, and infinitesimal, when compared with the injury effected by disproportionate development, such as is occasioned by the loss of some characters, or the greater, or less reduction of some only of the features. In the first case, viz., of proportionate reduction, the evils would begin to manifest themselves, only after long-continued (say, a score of generations of) close-interbreeding of the nearest relatives. In the second case, viz., of disproportionate development, the evils would begin to display themselves, in the first stage of interbreeding, either, with the furthest removed individuals of the same variety, or with individuals in the relation of cousins, or of father and daughter, or of brother and sister; or after several generations of interbreeding, in any of the degrees of relationship; according to the degree of such disproportionate development.

An individual may be twice, or thrice, the size of its fellows, and have most of its organs twice, or thrice the size they are, in others of its species; yet, if one of

its organs, be not of proportionate size, with the other features (—and the disproportion may lie, either, in being smaller, or larger, in proportion, than the other organs, and, even though the organ, out of proportion, be greatly superior in size to the same organ, as it exists in the other individuals—), the evil manifesting itself in interbreeding, will, other things equal, be many fold greater, than in the smaller, well-proportioned individuals. There is, however, a limit which may be reached, to the size to which some organs,—notably those obviously of vital importance to the organic economy,—may be proportionately reduced, with but little evil resulting.

It is therefore, evident, that, breeders need not fear to reduce the size, if they have retained, as far as possible, the proportion of the characters. The interests of the breeder, and of the animal, are, generally, in the long run, identical. But, where the gain to the breeder, is so great,—as, in the instance of Bakewell's breeding small Sheep, for the purpose named, in the case of pushing the development of the wool in Sheep to an advanced degree, and in the extreme development of the udders in a small breed of Cattle, say, the Alderney,—and the injury to the animal is so little and so remote in its manifestation, the animals' interests may justly be made subordinate. Breeders, however, in their ignorance of the true laws of growth, and of interbreeding, work adversely to their own, and to the animals' interests, by suffering disproportion to exist in parts and organs which it is a matter of indifference, with them, whether they are developed or reduced,

but the development of which is necessary to fertility and vigor.

"In 1791," says Darwin (p. 126, Vol. ii, *Animals and Plants, &c.*), "a ram-lamb was born, in Massachusetts, having short, crooked legs, and long back, like a turn-spit dog. From this one lamb, the otter, or Ancon semi-monstrous breed, was raised. As these sheep could not leap over the fences, it was thought, they would be valuable," and it was deemed desirable to increase their number indefinitely.

But, this semi-monstrosity,—as it was so violative of the true proportion of the characters of its species,—could not but inevitably fall a victim to the extinction occasioned, always, under like circumstances, by inter-breeding. As a matter of fact, the breed, as Darwin records, did become extinct. That their disproportion was the cause of the extinction of this "valuable" breed, is clearly evidenced by the fact, that their extinction was not owing to their being supplanted by crossing with other breeds, or to any failure of theirs to transmit their peculiarities; for, first, they were esteemed "valuable," according to Darwin, and, therefore, pains must have been taken, as Darwin implies, to preserve the type; and, secondly, because they were peculiarly capable of breeding true to their kind, so far as they were capable of breeding at all; for Darwin says:

"These sheep are (were) remarkable from transmitting their character so truly that Col. Humphreys never heard of 'but one questionable case' of an Ancon ram, and ewe, not producing Ancon offspring," and "when they crossed with other breeds, the offspring, with rare

exceptions, instead of being intermediate in character, perfectly resemble either parent; and this has occurred, even in the case of twins."

It is possible, however, that this monstrous peculiarity might have been retained, and that without inducing lessened fertility; if only care had been taken that no other features of disproportion remained.

It is susceptible of a very easy explanation why Darwin, in his exposition of the process of Natural Selection, failed to record this factor, viz., of the gradual extinction of all organisms which departed far from the type of the sum of all the positive characters of their respective species; and, conversely, viz., of the assured perpetuation of their kind, by individuals which realized or approximated such perfect type. Had the phenomenon been in accord with his theory, he would not have ignored it, as he has done; but would have rung all the changes upon it, *ad nauseam.*

The conditions of nature seem to be more propitious to the development of Cattle and of Horses, than to that of most other species. Most other species, have had many of their characters reduced or suppressed, but, with Cattle, especially, the existing state of nature seems to afford a better *habitat*, than does domestication. The wild cattle not only present, to the eye, an almost perfect symmetry of development, but the close-interbreeding which they withstand, with no or little evil effect, is a proof of their proportionate development. As Darwin has before remarked, they are generally sired by only one bull, which, older and stronger than the others, compels the closest inter-

breeding. The half-wild Chillingham, Pembroke, and other cattle, justify the theory of a one only, perfect type, by the results they afford, of in-and-in breeding. Domestic Cattle, which are,—as compared with the half-wild breeds,—degenerate, so far as symmetry of build is concerned, would, if placed under the same conditions as to their interbreeding, as are the Chillingham, and Pembroke breeds, have never been able to be preserved so long from extinction.

Referring to these half-wild Cattle, Darwin says (p. 148, Vol. ii, *Animals and Plants, &c.*):

"The half-wild Cattle, which have been kept in the British parks, probably, for 400 or 500 years, or even for a longer period, have been advanced by Cully and others, as a case of long continued interbreeding within the limits of the same herd, without any consequent injury."

This instance of Cattle, sired by one bull, at each successive period, during 500 years and over, is a fair test of the truth of the theory of proportionate development. It is the more remarkable, because Darwin says, each herd has of late been kept down by slaughter and by fighting to the average number of fifty. But their appearance, form and size, render their exemption from loss of fertility, and of constitutional vigor, in no wise surprising. They but fulfill the requirements of the theory, propounded in this work. All of their characters are developed, and proportionately developed, in marked contrast with those of domestic breeds. Their horns (which in domestic animals are kept down, by man), are of enormous

size, and their hoofs and legs are well developed by exercise, which aids also the growth of all the features to which these are correlated. The close interbreeding is manifest, for it is probable, that one dynasty of autrocratic bulls, has ever been dominant.

Darwin remarks that, of late, it has been discovered, that they are bad breeders. But, this was to be expected, ultimately; for, it was natural, that such close interbreeding, for 500 years, within a breed, of late kept down to the number of fifty, would eventually augment the evil due to those slight defects of structure, which are implied by the very capacity, of man, to discriminate between the individuals. Darwin contrasts their alleged, present, bad breeding, with the fertility of the wild herds of South America. But, the individuals of the wild herds of South America, occasionally repair their slight deficiencies, in structure, by intercrossing with other individuals, possessing slight, positive differences, due to their being reared, under slightly different conditions.

The principle, that animals, but little defective in proportion, display, when interbred, the evil of the little defects they have, by means of decrease in size, is confirmed by what is known of these half-wild Cattle. Darwin says (p. 149, Vol. ii, *Animals and Plants &c.*):

"The decrease in size, from ancient times, in the Chillingham and Hamilton cattle (wild), must have been prodigious, for Professor Rütimeyer has shown that they are almost certainly the descendants of the gigantic Bos *primigenius*."

This Bos, from which, also, all our domestic Cattle have descended, is described by Cæsar, as being not much inferior to the elephant in size.

The decrease in size, from interbreeding, is due to the reverse reason of that of the increase in size, attendant upon crossing. The latter namely, increase of size resulting from crossing two breeds, is owing to room having to be made, in the offspring, to allow of the combination of the characters contributed by both parents. The decrease in size referred to, is due to the saving of interstitial space, due to the augmentation of the similar defects of the parents interbred.

The principle of the decrease in size, from interbreeding animals, with but slight defects of proportion, is further illustrated by the case of the Sebright Bantam (Fowl). This animal was produced by many very complicated crosses, until, at least, the bases of all or nearly all the characters of the Fowl, were united in it. Then it was closely interbred for a long period, which gradually reduced its size, so that it now weighs but one pound!

It is clear, that, when the different breeds cross, some of the deficiencies of each, are corrected by the positive differences, or by the special excellence, of another; and that such result must, *ex hypothesi*, bring, with it, increased fertility and constitutional vigor. This is shown by Darwin's facts. But, the increase in fertility is less, in the case of Cattle, and of Sheep; because they are little divergent in character, and because there is little room for improvement. The crossing of varieties of the Pigeon, and of varieties of the Fowl, is

attended with the greatest increase of fertility, because the many widely divergent varieties of these species, necessarily imply great disproportionate development, of each variety. They are, therefore, extremely susceptible to improvement, because they lack so many characters; and, when two varieties, of one of those species, cross, there results, to the offspring, the accession of some important character which one of the parents lacked.

The different breeds of Cattle, and of Sheep, on the other hand, approximate closely to the sum of all the characters of their respective species. There is, therefore, comparatively little, to be gained, by any one of these breeds, from a cross. The positive differences, distinguishing the other varieties, are very few, very slight, and of comparatively little importance.

Strikingly in harmony with this interpretation, is the fact, that the more highly-bred the Pigeons are, the greater, is the gain, from a cross. The reason is, because the more highly-bred the breeds are, the more divergent they are; the more distinct they are; and the greater is the need for each to possess the characters which, in the others, have been pushed to an extreme point.

Equally congruous, is the converse fact, namely, that the more highly-bred, generally, that the breeds of Cattle and of Sheep, are, the less is the gain from the crossing of two varieties of one of the species. This is because, the more highly-bred the breeds of Cattle and of Sheep, become, the more, generally, do they all converge to the full and proportionate development of

all the characters of their species, and, therefore, the less are the differences between them. It is, only when each variety lacks very much that the other crossed variety possesses, that great good results. There is but little margin, for increase of good, with varieties of Cattle and of Sheep, because those varieties, generally, have nearly all the development, which is required for perfection. The results from crossing varieties of these last-named species, are generally shown, mainly, in increase of size, and in some accession of vigor.

Darwin says (p. 149, Vol. ii, *Animals and Plants, &c.*):

"Although, by the aid of careful selection, the near interbreeding of sheep, may be long continued, without any manifest evil, yet it has often been the practice, with farmers, to cross distinct breeds, to obtain animals for the butcher, which plainly shows that good is derived from this practice. Mr. Spooner sums up his excellent Essay on Crossing, by asserting, that there is a direct pecuniary advantage, in judicious cross-breeding, especially, when the male is larger than the female. A former celebrated breeder, Lord Somerville, distinctly states, that his half-breeds from Ryelands and Spanish sheep, were larger animals than, either, the pure Ryelands, or pure Spanish sheep."

The reason of the increase of size, attendant upon crossing, is not only because of reversion to the original type (which was of a size, sufficient to cover any at present existing individual of the given species), but, also because greater size, or room, is demanded in the offspring of a cross, in order to accommodate the peculiarities of both parents. The reason, increase of size from a cross, is especially observable, when the male is

larger than the female, is, as we shall see, when treating of generation, because the formative capacity of the male element is of an exogenetic character, and has a peculiar, but not an exclusive influence, over the development of the periphery of the organism.

With respect to the Crossing of Cattle, Darwin says (p. 147, Vol. ii, *Animals and Plants &c.*):

"Although, by carefully selecting the best animals, close-interbreeding may be long carried on with Cattle, yet the good effects of a cross between almost any two breeds, is at once shown by the greater size and vigor of the offspring; as Mr. Spooner writes to me, 'crossing distinct breeds certainly improves Cattle, for the butcher.' Such crossed animals are, of course, of no value to the breeder, but they have been raised during many years, in several parts of England, to be slaughtered; and their merit is now so fully recognized, that at fat-cattle shows, a separate class has been formed for their reception. The best fat ox, at the great show at Islington, in 1862, was a crossed animal."

The reason why, as Darwin asserts, such crossed animals, though "their merit is now so fully recognized," "are of course of no value to the breeder," is, because they will not persist in one type, but drop offspring, of every variety of improved types, though with no one excellence predominant. They have, united, in them, the peculiarities of two varieties, and this combination stimulates all the other centres of growth. The breeder desires to develop each excellence, in a different variety. In one, he wishes to have fine meat-producing qualities; in another, quantity of milk; in another, good butter-making capacity, &c. On the

other hand, the offspring of a cross, whilst it abates the extreme degree of each excellence, is bent upon the proportionate development of all its characters and capacities; and that is why it and the breeder cannot agree. If is, perhaps, the only fair show, that the poor animal has had, for "millions of generations," to regain the proportionate development of all the characters of its species; and, it endeavors to avail itself of the golden opportunity. But, the breeder, disgusted with such "*Vielseitigkeit*," and imbued with the wisdom of that sound, old English proverb, that "Jack of all trades can be master of none," ships the poor wretch off to the butcher; and individuals, only, which respectively restrict their improvement to the special quality which the breeder has assigned them; which patiently suffer their other structural, and functional points, to remain little developed; and which do not aspire to become Goethes, are allowed to propagate their kind.

The breeder desires persistency of type, in his animals. However good, the product may be, he does not want offspring of one and the same cow, to possess, the one, the excellence of a Durham, the other, the peculiar excellence of an Alderney, another that of a Jersey, and another to be like a Chillingham. He desires to be able, to count upon the character, of the calves which his cows will drop. Mongrels are too diversified; they yield too many characters to suit the breeder. Each mongrel-calf seems bent upon regaining its lost integrity, in a different way, from the others. This, to the breeder, is positively disgusting.

He would have them, to be all alike, in some one character, so that he may give them a name, and form a breed of them. He cannot count, with any confidence, upon a mongrel-cow, with a fine butter-making capacity, dropping a calf of its kind. For aught he knows, the offspring may wantonly forego the character of an Alderney, and develop, instead, fine meat-growing qualities. Such results occasion emotions, within the breeder, similar to those indulged by a bow-legged man, driving a pig to market. The breeder is so imbued with the love of order, and of regularity, that it positively piques him, to have one animal, with one set of characters, producing offspring each of which has started a different ratio of characters for itself; or producing several calves which have, more or less, succeeded in acquiring all the peculiarities of every breed. How is he, in such a case, to give them a name? to call them a certain breed? His desire, is that they shall be content, with one special peculiarity alone; whereas, every individual, which is dropped, seems to be pushing on, to the recovery of the mould of "some ancient progenitor," in a different direction, or in all directions; which direction, or sum of them all it will not even adhere to, but it, in its turn at this confusion worse confounded, drops offspring, with some different character slightly in the ascendant, or with an altogether different ratio from them all. What cares the breeder for their repaired integrity? What he aims at, is to get them with one special character, only, developed. The capacity of these mongrels to withstand close-interbreeding, for dozens of genera-

tions, without injury, pleads in vain for their lives. The butcher closes the last scene of all.

Is it any wonder, that crossing is regarded, with aversion, by every breeder?

"Until quite recently," says Darwin (p. 122, Vol. ii, *Animals and Plants, &c.*), "cautious and experienced breeders, though not averse to a single infusion of foreign blood, were almost universally convinced, that the attempt to establish a new race, intermediate between two widely distinct races, was hopeless; 'they cling with superstitious tenacity, to the doctrine of purity of blood, believing it to be the ark in which alone true safety could be found.'"

And again he says, not of Cattle and Sheep especially, but of all animals (p. 122, Vol. ii, *Animals and Plants, &c.*):

"As cross-bred animals are, generally, of large size and vigorous, they have been raised in great numbers, for immediate consumption. But, for breeding, they are found to be utterly useless; for, though they may be themselves uniform in character, when paired together, they yield during many generations, offspring astonishingly diversified. The breeder is driven to despair, and concludes that he will never form an intermediate race. But, from the causes already given, and from others which have been recorded, it appears that patience alone is necessary; as Mr. Spooner remarks 'nature opposes no barrier to successful admixture; in the course of time, by the aid of selection and careful weeding, it is practicable to establish a new breed.' After six or seven generations, the hoped-for result will, in most cases, be obtained; but even then, an occasional reversion, or failure to keep true, may be expected. The attempt, however, will assuredly fail, if

the conditions of life be decidedly unfavorable to the characters of either parent breed."

It is for this object, namely, the formation of new varieties, that crossing is resorted to. It is also resorted to, as seen above, to procure fine animals for immediate consumption. The other reason that it is adopted, is to ward off the evils which have accrued, from interbreeding. This motive seldom obtains with respect to Cattle and Sheep, unless there has been very long-continued and very close-interbreeding. With animals, like the Pigeon, the Fowl, and the Pig, as has been already shown, breeders of the high fancy breeds are constantly compelled to have recourse to crossing. Yet, even with Cattle and Sheep, the breeder, in pushing the peculiarity, of a breed, to an extreme point, needs must interbreed the individuals; this leads to its natural, evil results; and crossing is then required. The criterion, generally, with breeders, of the good resulting from a cross, is, whether the offspring has improved or deteriorated, in the quality precious to the breeder. It may have improved most wonderfully, in a physiological sense, and have regained every character of its species, in a comparatively high degree of development; yet, if it has abated the least, in the special excellence required for the breeder's purpose, it is esteemed shamefully deteriorated; although all immunity from danger, for tens of generations, from the closest interbreeding, may have succeeded previous loss of (nigh) all fertility.

When a breed is suffering from the results of close-interbreeding, there is no necessity to cross with a

very distinct breed. The slight, positive differences of a near variety, or of a different strain, will frequently suffice to ward off the evils of disproportion; and by this crossing with a different strain only, the special excellence of the breed is saved from injury, or from abatement, while sufficient vigor and fertility are acquired. It is even possible, to bring up the individuals, to the original, perfect type, by merely taking advantage of the slight, positive differences which present themselves at times in the individuals of the same variety. As Darwin's facts show, breeders have learned, that it is not necessary to cross the animals of a variety, with a very distinct variety, in order to stave off the evil of interbreeding. Breeders, however, are just as likely as not, in crossing, to select those individuals of a different strain or sub-variety, which have *negative* differences distinguishing them, as they are to cross their animals with the individuals of such different strain, which have positive peculiarities to contribute to the offspring. Breeders, together with Darwin, fancy, that the good resulting from a cross, is due to difference, *per se;* whereas, it is solely *positive*, differences, from which the favorable result accrues.

CHAPTER XI.

The Crossing, and the Self-Fertilization, of Plants.

In Chapter vi, on the processes by which races have been formed under nature, and varieties have been formed, under domestication, it was shown, that Plants have been greatly modified. Not only do the improvements which arise, under domestication, imply the previous loss and reduction of many organs and features; but, this conclusion is incontestably established by Darwin's testimony, to the effect, that,

"With species in a state of nature, rudimentary organs are so extremely common that scarcely one can be mentioned which is free from a blemish of this nature;"

And, in Chapter iii, authority from Darwin has been adduced to the effect, that nearly every species of Plant has had organs, either reduced, made rudimentary, or completely suppressed, with no vestige of their past existence left. These organs, he asserts, have first become of less and less use and ultimately superfluous. He shows, in detail, that there is scarcely an individual plant, under nature, which has not some of the features of its species, absent. Some one, or several, of the following characters, viz., Stamens, stems, tendrils, tubers, roots, leaves, fruit, flowers, pistil, calyx,

corolla, anthers, ovules, stigma, ovaries, seeds, seed-capsules, medicinal qualities, &c., are, save in a few exceptional cases, found to be wanting, in each Plant, as it exists under nature. Besides the loss of one, or of several of these characters, there is a false ratio of the development of those remaining. Frequently, too, though developed, in structure, characters are rudimentary, in function.

Nor is this degeneration, in structure (necessarily resulting, *ex hypothesi*, in lessened fertility and sterility), at all remedied, when the plants are placed under domestication. The physiological injury has only been augmented, by the "*improvements*," which Man has effected. As Darwin confesses:

"Cultivated races of Plants often exhibit an abnormal character, as compared with natural species; for they have been modified, not for their own benefit, but for that of Man" (page 14, Vol. i, *Animals and Plants, &c*).

Man even augments the degeneration, commenced by the adverse conditions of nature:

"With cultivated Plants," says Darwin (p. 380, Vol. ii, *Animals and Plants, &c.*), "it is far from rare, to find the petals, stamens, and pistils represented by rudiments, like those observed in natural species. So it is, with the whole seed, in many fruits. * * In certain varieties of the gourd, the tendrils, according to Naudin, are represented by the rudiments, or various monstrous growths."

In fact, it is not possible to mention any organ, or part of a plant, which has not, in some species, under cultivation, been systematically or unintentionally re-

duced by Man; under the ignorant impression that it is useless.

Together with the reduction of certain characters, by man, there ensues a reduction of other features, to which the first are correlated. With respect to these, Darwin speaks most learnedly, of "a *natural tendency*, in certain parts, to become rudimentary."

"In the Broccoli and cauliflower," says he, "the greater number of the flowers are incapable of expansion, and include rudimentary organs. In the Feather hyacinth (Muscari *comosum*), the upper, and central florets are rudimentary; under cultivation, the tendency to abortion travels downwards and outwards, and all the flowers become rudimentary. * * In these several cases, we have a natural tendency (*sic*) in certain parts, to become rudimentary, and this, under culture, spreads either to, or from, the axes of the Plants. * * According to A de Jussieu, the abortion is only partial, in Carthamus *creticus*, but more extended in C. *lanatus;* for, in this species, two or three alone, of the central seeds, are furnished with a pappus, the surrounding seeds being either quite naked, or furnished with a few hairs; and, lastly, in C. *tinctorius*, even the central seeds are destitute of pappus, and the abortion is complete."

But, not merely by the degeneration, effected under nature, and by the systematic, or the unintentional reduction or suppression of organs, by Man, is the structural and the physiological integrity of Plants, impaired. Man's object, in cultivating Plants, is to increase their development. But, the manner in which he strives to effect this, only adds to the physiological injury. For, he vitiates, the more, the true proportion, by selecting

some one part only, of a Plant, and pushing its development to an extreme point!

This is the dominant feature of Man's Selection, with Plants,—viz., the disproportionate ascendancy of one part or organ. All of the modes of Selection may be discerned, with Plants, but this carrying of one part alone to an extreme development peculiarly characterizes the cultivation of these organisms.

If it be the fruit, which he values, that character alone is developed, and all of the other features are retained in *statu quo*, or still further reduced.

If it be the leaves, or the flowers, or the roots, or any other part which, in a given species, subserves his pleasure or profit, the same disproportionate development is to be seen; and, the individuals are but the more injured, in their reproductive power, by the care which is bestowed upon them. All the parts of the given species, are not concurrently re-developed, in each individual.

As Darwin shows (p. 14, Vol. i, *Animals and Plants, &c.*), cultivated varieties of Plants "show adaptation to his (Man's) wants and pleasures."

In order to disclose the cause of the greatly lessened fertility of Plants, after they are placed under domestication, it may be advisable, again to quote Darwin's description of the manner which Man adopts, in the cultivation of plants. Under the heading of "*Tendency in Man to carry the practice of Selection to an Extreme Point*," he says (p. 290, Vol. ii, *Animals and Plants, &c.*):

"It is an important principle, that, in the process

of selection, *man almost invariably wishes to go to an extreme point*," *i. e., with some one character only.* "On the whole" (p. 266, Vol. ii, *Animals and Plants, &c.*), "we may conclude that *whatever part or character is most valued,—whether the leaves, stems, tubers, bulbs, flowers, fruit, or seed of Plants * * *—that character will, almost invariably, be found to present the greatest amount of difference, in kind, and degree.* And, this result may be safely attributed to man having preserved, during a long course of generations, the variations which were useful to him, and neglected the others."

And again he shows (page 34, *Origin of Species*), that there are great differences, in the parts which are valued, and no or little differences, in the parts neglected; which is owing to the parts, which are valued, being retained at each stage of their re-development, while the parts, not valued, occupy a common level of degeneration!

"Compare," says he, "the diversity of Flowers, in the different varieties of the same species, in the Flower-garden; the diversity of Leaves, Pods, or Tubers, or whatever part is valued, in comparison with the Flowers, of the same varieties; and the diversity of the Fruit, of the same species, in the Orchard, in comparison with the Leaves, and Flowers, of the same set of varieties. See how different, the Leaves of the Cabbage are, and how extremely alike the Flowers; how unlike, the Flowers of the Hearts-ease are, and how alike the Leaves; how much the Fruit of the different kinds of Gooseberries, differ in size, color, and hairiness, and yet the Flowers present very slight differences. It is not, that the varieties which differ largely, in some one point, do not differ at all in other points. * * * The laws of Correlation of growth,

the importance of which should not be overlooked, will ensure some differences, but" (the exclusive and continued selection, by man, of those parts only, which he values, in the Plants, be it) "the Leaves, the Flowers, or the Fruit, will produce races differing from each other, chiefly in those characters."

Again he says (page 509, Vol. ii, *Animals and Plants, &c.*):

"The best proof of what selection has effected, is perhaps afforded by the fact, that whatever part or quality, in any animal, and more especially in any Plant, is most valued by Man, that part or quality differs most, in the several races. This result is well seen, by comparing the amount of difference between the Fruits, produced by the varieties of the same Fruit tree; between the Flowers of the varieties, in our Flower-gardens; between the Seeds, Roots, or Leaves of our culinary and agricultural plants, in comparison with the other, and not valued parts of the same plants."

Each species, under cultivation, departs from its degenerated type under nature, only in that way which will be serviceable to man. If it should essay the re-development of any other part, than that for which it is valued, it will be destroyed. As Darwin says:

"With all improved Plants * * they examine the seedlings, and destroy those which depart from the proper type" (p. 242, Vol. ii, *Animals and Plants, &c*).

Is it any wonder, then, considering the many characters, which are reduced and suppressed, in each plant, and the false ratio which is established with the characters remaining, which is increased in proportion as the one part valued is pushed out of all proportion, that (as

Darwin notes, in profound ignorance of the reason, p. 9, *Origin of Species*), "STERILITY HAS BEEN SAID TO BE THE BANE OF HORTICULTURE;" and, that so many plants become self-impotent?

Strange, mysterious, and inexplicable seem, to Darwin, to be the many phenomena of self-impotent Plants, recorded by him; but, the disorder is resolved into the fullest harmony, when it is observed, THAT THE LESSENED FERTILITY AND LESSENED VIGOR, ATTENDANT UPON INTERBREEDING AND UPON SELF-FERTILIZATION, ARE EVER PROPORTIONATE TO THE PLANTS' DEPARTURE FROM THE TYPE OF THE SUM OF ALL THE POSITIVE PARTS OF ITS SPECIES; AND THAT GAIN IN FERTILITY AND IN CONSTITUTIONAL VIGOR FROM CROSSING, IS DUE TO EITHER OF THE CROSSED PARENTS CONTRIBUTING A CHARACTER OR CHARACTERS WHICH THE OTHER PARENT LACKS, AND TO THE CONSEQUENT REMOVE WHICH IS MADE TOWARDS THE ORIGINAL, PERFECT TYPE OF THE GIVEN SPECIES.

It is not by the exclusive development "of the part valued," to the neglect, or suppression of the other characters, that any Plant may progress toward perfection. The further such culture is carried, the worse it becomes, physiologically, for the plant; for, the more is its balance disturbed.

Darwin talks about "serious defects in structure," and about the policy of not violating "the mutual relation of the parts." If he had but availed himself of such ideas, to resolve the phenomena which he records, he would have spared himself the mortification of confessing his ignorance of the many phenomena of

sterile, and of self-impotent plants. Those ideas,—viz., "serious defects in structure," and "mutual relation of the parts,"—are the threads which will lead the inquirer, safely through the labyrinth of plant-sterility.

As the development, of the different varieties of Plants, differs; and, as positive characters are generally found, in each, which are absent in the other varieties, it becomes matter of little surprise, that good,—viz., constitutional vigor, and fertility,—flows from the crossing of two varieties.

To show, that the reproductive organs are not necessarily implicated, in this good resulting from a cross, it is necessary only to refer to the phenomena, which Darwin gives, showing that the good, from the union of two varieties, is displayed, even when the union is effected by Grafting!

In order to improve in fertility and vigor, nothing more is needed, than the accession, to the individual, of characters which it lacked. It is immaterial, how this may be effected. The gain to physiological integrity accrues, whether the return, to the sum of all the positive characters of the species, be secured by means of Reversion, of Crossing, or of Grafting!

The following are proofs, from Darwin, showing the evil, entailed by the reduction of characters to a rudimentary condition, and entailed by the disproportionate development, effected by Man, in attending exclusively to the culture of some one part which he values, in a Plant. It must be noted, in connection with these proofs, that Darwin is, confessedly, in profound ignorance, both of their cause, and of the reason

of the many variations in the quantity of the effects. He traces many of the phenomena to the action of the conditions; but, he truly recognizes that such are but *conditions*.

On page 136, Vol. ii, *Animals and Plants, &c.*, he says:

"I raised a number of purple-flowered, long-styled seedlings (of Primrose) from seed, kindly sent me by Mr. Scott, and though they were all in some degree sterile, they were much more fertile, with pollen taken from the common Primrose, than with their own pollen."

To understand the philosophy of this, we need only turn to Darwin's statements, showing that, in plants, valued alone for their flowers (as is the Primrose), the development of this especial excellence, is pushed to an extreme point, while the other portions of the organism, viz., the seed, seed-capsules, ovules, ovaries, leaves, roots, &c., are neglected, reduced, or suppressed. The true ratio of the development of the characters, is vitiated by the abnormal disproportion of the flowers. When a cultivated variety of the Primrose is crossed with the common Primrose, good results, because some of the characters which, in the cultivated plant, are reduced or suppressed, are supplied; and the evil is also remedied, by means of the abatement, in the extreme and disproportionate development of the Flowers, which ensues.

Again he says (page 164, Vol. ii, *Animals and Plants, &c.*):

"It has recently been discovered, that certain plants,

whilst growing in their native country, under natural conditions, cannot be fertilized with pollen from the same plant. They are sometimes so utterly impotent, that though they can readily be fertilized by the pollen of a distinct species, or even distinct genus, yet wonderful as the fact is, they never produce a single seed by their own pollen. In some races, moreover, the plant's own pollen and stigma mutually act on each other, in a deleterious manner."

In all of these plants, so self-impotent, and of injurious self-action, there are to be found many of the organs reduced to a rudimentary condition; in some cases, with the rudiments still traceable; and, in others, with not, as Darwin shows, a single vestige of the lost characters, discernible.

Darwin fancies, that these parts which are wholly lost, and these rudimentary parts, have "first become of less and less use and then absolutely valueless." But, valueless as he may esteem them, they, by their absence, work serious effects upon the constitution, and upon the capacity of the reproductive elements, which can never regain their full potency and vigor, until these lost and rudimentary characters are fully re-developed. The perfect type alone, is consistent with physiological integrity; and, the various degrees of lessened fertility and of sterility, which are empirically noted by Darwin, are but the registers of the several degrees of departure from such type.

Even in Plants, seemingly very much alike, there are positive differences which, if united in an individual, or united in the reproductive elements, will frequently, where the parents are but little prolific,

enhance the fertility; or, where the parents are self-impotent, restore the reproductive power.

As Darwin has said:

"It is not that the varieties which differ largely in some one point, do not differ at all in other points. The laws of Correlation, the importance of which should not be overlooked, will ensure some differences."

The slightly different conditions of plants, growing along side of each other, will entail a dissimilarity of development, which will furnish occasion for good from a cross between them. This applies, not merely to different plants, but even to the different sets of reproductive elements, growing upon the same plant! By the following remarks, Darwin shows, what little differences, in the conditions, entail different modifications of the specific type:

"Even the seeds," he says (p. 304, Vol. ii, *Animals and Plants, &c.*), "nurtured in the same capsule, are not subjected to absolutely uniform conditions, as they draw their nourishment from different points."

This explains the reason of cases like the following, where the action of the same pollen is widely different, according as it is placed upon the stigma of the same flower, upon the stigma of a flower on the same twig, upon the stigma of a flower on another bough, or upon the stigma of a flower on a different plant. It is possible for Darwin to see, that, in many such cases, the good derived, is in proportion to the differences between the organisms, or to the differences between the parts, of organisms, contributing the reproductive elements.

But he does not see, that this distinction is required, only where there is disproportionate development; nor does he perceive, that the difference works fertility, merely because it implies the contribution, by each parent-form, of the forces of some characters which are wanting in the other.

"Sixty-three flowers," says Darwin (p. 164, Vol. ii, *Animals and Plants, &c.*), "of Corydalis *cava*, born on distinct plants, were fertilized by Dr. Hildebrand, with the pollen from other plants of the same species; and fifty-eight capsules were obtained, including, on an average, 4.5 seed, in each. He then fertilized sixteen flowers, produced by the same raceme, one with another, but obtained only three capsules, one of which alone produced any good seeds, namely two in number. Lastly, he fertilized twenty-seven flowers, each, with its own pollen; he left also fifty-seven flowers to be spontaneously fertilized, and this would certainly have ensued, if it had been possible, for the anthers not only touch the stigma, but the pollen-tubes were seen by Dr. Hildebrand to penetrate it; nevertheless, these 84 flowers did not produce a single seed capsule. This whole case is highly instructive, as it shows how widely different the action of the same pollen is, according as it is placed on the stigma of the same flower, or on that of another flower on the same raceme, or on that of a distinct plant."

Here, Darwin wisely and grandiloquently asserts, that the fact of "the widely different action of the same pollen," "is highly instructive," because (*sic*) "it shows how widely different the action of the same pollen" is! This is a clever device, by which Darwin frequently conceals his inability to explain the phenomena which he records. The student is naturally

solicitous to know the reason of this widely different action of the same pollen. Darwin, by a dexterous re-statement of the very facts which were to be explained, insidiously conveys the idea that, by so re-stating them, he has achieved a full solution.

This is on a par with the explanation, he affords, of the reason why animals and plants vary,—Because, they possess an "innate tendency to vary!"

But, if he had revealed the true reason of the widely different action of the same pollen; if he had shown, that the reason sterility existed, was because of the evil due to the disproportionate development of the plants, which evil self-fertilization but augmented; and had shown that the regain of the lost fertility, was due to the different reproductive elements having added together their slightly different coördinating forces, and thus secured the complement necessary for reproduction; the result would have been disastrous to his hypothesis of the Origin of Species; for, it would have proven the normal immutability of each species, and the impossibility of any organism's departure from a certain set of characters, peculiar to its species, save at the cost of its physiological integrity.

On page 174, Vol. ii, *Animals and Plants, &c.*, he speaks of "Plants becoming, under culture, self-impotent. A cutivated plant, in this state," he continues, "generally remains so during its whole life, and from this fact, we may infer that the state is probably congenital." The breeder has but to abate the abnormal development of the part which he values, and to develop the parts reduced, or suppressed, to have the

self-impotence "vanish like a morning cloud" (as Tyndall has it), "into the infinite azure of the past." "Kolreuter, however," continues Darwin, "has described some plants of Verbascum, which varied in this respect, even during the same season." If the plants had suffered a change, from comparatively favorable, to poor conditions, of light, heat, electricity, chemical elements, &c., and this change had lessened the vigor of the neglected parts of the plants, this variation from fertility to sterility, during the same season, would be explicable. Or, if the favorable conditions were peculiarly propitious to the advanced development of the special excellence of the plants, this improvement in one character alone, would, through affecting the proportion, induce self-impotence. In corroboration of this last remark, is the following from Darwin (p. 380, Vol. ii, *Animals and Plants, &c.*):

"In the Compositæ, the so-called doubling of the flowers consists in the greater development of the corolla of the central florets, generally accompanied with some degree of sterility."

This sterility results, because the corolla alone, of the central florets, and the central florets alone, have been greatly developed, without the concurrent development of the other florets, of the other parts of the central florets, and of the several leaves, racemes, stamens, branches, pistils, anthers, and other characters normally proper to the given species. As a consequence, the true coördination has been impaired,—all the parts have not been brought into harmony with each other. If the parts valued are

pushed any further, out of proportion, or if the less-valued or neglected parts are any further reduced, the "some degree of sterility" will be succeeded by self-impotence.

According to Darwin's own showing, there are many plants which are capable of self-fertilization, without any apparent evil resulting to them from the process.

It is manifest, to the reader, that these owe their fertility, to the absence of all reduction, in them, of any of the characters of their respective species; or to such reduction, as they may have, being too little, in degree, to have much effect upon their reproductive powers.

Then, there are many plants which display lessened fertility, from self-fertilization.

These are disproportionately developed, to an extent sufficient to effect their fertility, but not sufficient to render them self-impotent.

Again; there are many plants which are wholly self-impotent.

These have many of their characters reduced to a rudimentary condition, or so completely suppressed as not to leave a vestige of their past development. From these two latter classes, namely, of plants self-impotent, and plants with their fertility lessened, Darwin has empirically generalized the conclusion, that self-fertilization is radically injurious. Those, however, among the more intelligent of botanists who are sufficiently well disciplined in scientific habits of thought, to see that his "great law of nature" is manifestly an incomplete induction, have openly questioned the validity of Darwin's conclusions; and to warrant their skepticism,

have appealed to many plants, of the first-class,—namely, those which are very fertile, though self-fertilized,—which conclusively show, that, however much evidence Darwin may accumulate to justify his "law," there is an immense array of evidence which obviously militates against any such induction as he would fain draw.

Darwin, piqued by the distrust displayed, in many quarters, towards his "law of nature," resolutely determines to confound all of the incredulous, by the results of a series of experiments which he has partially made, and which he intends to continue. He declares, that he intends to "*settle forever*" the question, by means of the experiments he is now conducting, with many plants of a certain species.

It will, doubtless, be the occasion of some amusement to those who find that the theory of proportionate development reconciles all of the vast array of seemingly conflicting evidences, on this point, to see Darwin patiently experimenting with many plants of one species, in the full confidence, that his results will confound all of those who dared to draw into question what he, the autocrat of the world of natural history, had declared to be a "law of nature."

The cream of the joke lies in this, That the results, of his experiments, depend entirely upon the structural condition of the species, which, he fixes upon, with which to experiment! If the species he were to determine to use, had, as its individuals, ones which had no characters reduced to a rudimentary condition, or had no character pushed to the extreme of develop-

ment, whilst the others remained reduced, his "great law of nature" would be completely negatived. If, however, the individuals of the species, were, comparatively, little disproportionately developed, his heart would be rejoiced, to find that some evil did result from self-fertilization, and that, on the other hand, good resulted from a cross between varieties of such species. If again; he chose a species that had many of its characters reduced to a rudimentary condition, and had one or two only of the remaining characters pushed to an extreme of development, the results of his experiments, would be, in his eyes, so signal and conclusive, as to cause him regret that he had suffered himself to be ruffled, for a moment, by mere quibblers who had not taste enough to recognize the implicit deference they owed to genius so transcendant.

The following quotation, in which Darwin gives assurance that he intends "forever (to) settle the question," is rich.

"Experiments have not been tried," says he (pp. 157–8, Vol. ii, *Animals and Plants, &c.*), "on the effects of fertilizing flowers with their own pollen, during several generations. But, we shall presently see that certain plants, either normally or abnormally, are more or less sterile, even in the first generation, when fertilized by their own pollen. Although nothing is known on the evil effects of long-continued close-interbreeding, with plants, the converse proposition, that great good is derived from crossing, is well established.

"With respect to the crossing of individuals belonging to the same sub-variety, Gärtner, whose accuracy and experience exceeded that of all other hybridizers, states that he has many times observed good effects

from this step (crossing), especially with exotic genera, of which the fertility is somewhat impaired, such as Passiflora, Lobelia and Fuchsia. Herbert also says, 'I am inclined to think that I have derived advantage from impregnating the flowers from which I wished to obtain seed, with pollen from another individual of the same variety, or at least from another flower, rather than with its own.' Again, Professor Lecoy asserts that he has ascertained that crossed offspring are more vigorous and robust than their parent.

"General statements of this kind, however, can seldom be fully trusted; consequently, I have begun a series of experiments which, if they continue to give the same results as hitherto, *will forever settle the question* of the good effects of crossing two distinct plants of the same variety, and of the evil effects of self-fertilization. A clear light will then be thrown (*sic*) on the fact that flowers are invariably constructed so as to permit, or favor or necessitate the union of two individuals."

With respect to this last statement, he has been a little negligent in the use of the word "invariably;" for, he himself gives cases of flowers so enclosed as to preclude all possibility of a cross. These enclosed flowers, too, are perfectly fertile, notwithstanding that their structure forbids the supposition, that there ever was anything, with them, but self-fertilization!

But, to accompany Darwin, in the experiments which are "forever to settle the question" of his "great law of nature:"

"The plan," continues he, "which I have followed, in my experiments, is to grow plants in the same pot, or in pots of the same size, or close together in the

open ground; to carefully exclude insects; and then to fertilize some of the flowers with pollen from the same flower, and others on the same plant with pollen from a distinct, but adjoining plant. In many, but not all, of these experiments, the crossed plants yielded much more seed than the self-fertilized plants; and I have never seen the reversed case. * * * Now, I have carefully observed the growth of plants raised from crossed and self-fertilized seed, from their germination to maturity, in species of the following genera, namely, Brassica, Lathyrus, Lupinus, Lobelia, Lactuca, Dianthus, Myosotis, Petunia, Linaria, Calceolaria, Miranda, and Ipomœa, and the difference in their powers of growth and of withstanding, in certain cases, unfavorable conditions, was most manifest and strongly marked." * * * * *

"I will briefly describe the two most striking cases as yet observed by me. Six crossed, and six self-fertilized seeds of Ipomœa *purpurea* from plants treated in the manner above described, were planted as soon as they had germinated, in pairs, on opposite sides of two pots, and rods of equal thickness were given them to twine up. Five of the crossed plants grew from the first more quickly than the opposite self-fertilized plants; the sixth, however, was weakly, and was for a time beaten, but at last its sounder constitution prevailed, and it shot ahead of its antagonist. As soon as each crossed plant reached the top of its seven foot rod, its fellow was measured, and the result was that when the crossed plants were seven feet high, the self-fertilized had attained the average height of only five feet, four and a half inches. The crossed plants flowered a little before, and more profusely than the self-fertilized plants. On opposite sides of another small pot, a large number of crossed and self-fertilized seeds were sown, so that they had to struggle for bare existence; a single rod was given to each lot: here

again, the crossed plants showed from the first their advantage; they never quite reached the summit of the seven foot rod, but relatively to the self-fertilized plants, their average height was 7 feet to 5 feet 2 inches." (This is a good instance of Darwin's Natural Selection. Although stronger and more vigorous than the other lot of plants in the same pot they were,—relatively to the plants, in the other pot, which had, each, a pole,to itself,—rather degenerated. If the conditions were made more unfavorable, they would—even whilst retaining their character of being stronger and more vigorous than those succumbing—be degenerating. Yet, Darwin, in his argument of Natural Selection, would have his readers believe, that the mere fact that they were stronger and more vigorous than those of their fellow lot, argued a net advance in development for the species). "The experiment was repeated in the two following generations, with plants raised from the self-fertilized and crossed plants, treated in exactly the same manner, and with nearly the same result. In the second generation, the crossed plants, which were again crossed, produced 121 seed-capsules, whilst the self-fertilized plants, again self-fertilized, produced only 84 capsules.

"Some flowers of the Mimulus *luteus* were fertilized with their own pollen, and others were crossed with pollen from distinct plants, growing in the same pot. The seeds after germination, were thickly planted on opposite sides of a pot. The seedlings were at first equal in height; but, when the young crossed plants were exactly one-half an inch, the self-fertilized plants were only a quarter of an inch high. But, this inequality did not continue, for when the crossed plants were four and a half inches high, the self-fertilized plants were three inches, and they retained the same relative difference, till their growth was complete. The crossed plants looked far more vigorous than the un-

crossed, and flowered before them; they produced also a far greater number of flowers which yielded capsules (judging, however, from only a few) containing more seeds. As, in the former case, the experiment was repeated in the same manner during the next two generations, and with exactly the same result. Had I not watched these plants of the Mimulus and Ipomœa during their whole growth, I could not have believed it possible, that a difference, apparently so slight as that of the pollen being taken from the same flower, and from a distinct plant growing in the same small pot, could have made so wonderful a difference in the growth and vigor of the plants thus produced. This, under a physiological point of view, is a most remarkable phenomenon."

It is to be lamented, that such experiments, so carefully and patiently conducted, and so faithfully reported, should add not a jot of weight to his "great law of nature;" that, such a simple idea, as the want of full structural integrity, should explain the lessened vigor, and the lessened fertility of self-fertilized plants; and, that the union of the different structural points, of the different plants, and the return, thereby effected, towards the sum of all the positive features of the species; should account for the good thence resulting. All of these "most remarkable" phenomena, are wholly inexplicable to Darwin. Yet, the explanation is so simple and clear. The self-fertilized plants are deficient in the integrity of their structural conformation; whilst, when crossed, the same integrity is measurably repaired, through each parent's supplying structural defects in the other, by means of the positive differences which distinguish it from the other. The

induced return, to the original type of the species, brings with it vigor and fertility.

Had Darwin but learned the lesson, which is fairly thrust upon him by so many of the facts of breeding,—prominent among which, and most significant, is the fact which he records, that the mere increase, of one-half an inch, to one of the sickle tail-feathers of the Fowl, "brings with it increased probability of increased fertility,"—all of the mystery of the phenomena of fertility, and of sterility, would have been dispelled; and all necessity of his invoking that most senseless of all expedients, a "law of nature," would have been obviated.

There is no occasion for the indulgence of such an idle and ignorant wonder, as that to which Darwin gives expression, when it is observed, that each of the positive differences, in the several individuals or varieties of a species, which it is possible, and practicable, for each plant to obtain, either, directly, by reversion, or by grafting, or, indirectly, through crossing, ensures a measurable return to the type upon which close-interbreeding, or self-fertilization, is incapable of entailing any evil effect. Each slight difference, which enables a person, acquainted with plants, to distinguish one from the others, is of moment to the plant; for, each such slight, positive difference gained, carries with it a guarantee of exemption from weakness and sterility.

Darwin says, "this, under a physiological point of view, is a most remarkable phenomenon." If he had but paid a tithe of the attention, to the "physiological

point of view," which he has given to the mere anatomical differences; or, if he had but thought, for a moment, what physiological effect must be wrought by anatomical changes; and if he had heeded the almost infinite number of hints which physiology has actually obtruded, but in vain, upon him; he would have been spared the egregious blunders which he has made; and, phenomena, instead of being insensately characterized by him, in ignorant wonder, as "remarkable," would have been fraught, to him, with knowledge of laws, the simplest and most beautiful possible.

Instead of being constrained, as he is, to regard his facts with the awe the savage shows to his fetich, he would have been enabled, *a priori*, to expect results which, now, he says, he could not have believed possible.

How any man, with the least tincture of scientific habits of thought, could range through such varying phenomena; could ignore the significance of their almost infinite variations in quantity of effect; could escape the conclusion, that the modification of a certain ratio of characters, underlies all the evil effects of close-interbreeding and of self-fertilization; and could so completely lull all of his scientific instincts, as to formulate an inflexible "law of nature," in derogation of such a wide diversity of effects; are mysteries which can be explained, solely by resorting to the one hypothesis that, "Motley's the only wear" for this standard-bearer of modern thought; or, to the other hypothesis, that the author of the *Origin of Species* systematically and wilfully ignored the element of

physiology, governed by the conviction, that the least insight, by his readers, into that phase of the problem, would suffice to explode his fanciful notion, that the higher animals are evolved from the lower.

Darwin, in connection with his "great law of nature," that good follows from crossing, *per se*, and evil from interbreeding, *per se*, is proof against any amount of evidence. In some cases, the evil from close-interbreeding, or from self-fertilization, is manifest; and, then he is exultant. In other cases, where it is clear, that close-interbreeding, or self-fertilization, may be long carried on, without any evil effects, he finds refuge in the supposition, that the animals or plants must have been crossed, at some time back.

But it is possible, and practicable, to prove even the negation of his gratuitous supposition. For there is one class of facts, recorded by Darwin, which should suffice to give his "great law of nature," its quietus. It is, viz., that certain flowers are *enclosed!*

These flowers are fertile! and the fertility must have been long continued; for, there is a radical impossibility that they ever were crossed. The only means, by which crossing, can be effected, is, either, by foreign pollen being conveyed to the stigmatic surface of the flower, by mechanical forces, winds, &c., or by the transportation of such, by bees, or other insects. But, in the cases mentioned, all ingress for foreign pollen, is absolutely precluded. The flowers, containing the stigmatic surface, are *enclosed;* and each flower needs must have been ever fertilized by its own pollen. Of these enclosed flowers, which he recognizes as milita-

ting against his "law," he speaks as follows (p. 116, Vol. ii, *Animals and Plants, &c.*):

"The Leersia *oryzoids* produces minute, *enclosed* flowers *which cannot possibly be crossed*, and *these alone, to the exclusion of the ordinary flowers, have as yet been known to yield seed.* (*!*) A few additional and analogous cases could be advanced. But, *these facts do not make me doubt, that it is a general law of nature,* that the individuals of the same species occasionally intercross, and that some great advantage is derived from this act."

Some great good is derived from the intercrossing of individuals of the same species, because they each have, in them, some positive point of structure, which is needed in every individual of the given species. In presence of facts, like these enclosed flowers, precluding the possibility of crossing, Darwin trims, somewhat, his "law." As he states his "law," elsewhere, it is an absolute necessity, that individuals of the same species should cross. Here, however, in the quotation above, he states it, in a manner which is very little defective.

"Some great advantage" is, undoubtedly, often "derived from this act" of Crossing. But, it is not a great "law of nature." It is due to structural defects in either parent being supplied by positive differences in the other parent.

When individuals of a species are disproportionately developed, a "great advantage is," without doubt, "derived from the act" of crossing. But, there is no "law of nature," requiring a cross. An individual, and its descendants, which have, each, all of the positive

characters of their species, need never cross, if their type is never modified. With them, a cross must needs entail evil upon them, instead of good. For, the only variety with which they could possibly cross, must necessarily be one, distinguished from them, by negative features, which ever work evil.

But, when individuals are deficient in some of the characters of their species, it is necessary, in order for good to accrue to their offspring,—in order for the physiological evil, attendant upon their structural defects, to abate,—that they regain the characters they lack. It is a law of nature, that all the characters, of a species, should be developed, in every individual of such species. The good accruing from a cross, is not due to crossing, *per se*, but to that accession, of extra characters, which a cross generally involves. The good flows, from the repair, made to the lost integrity, by the addition, in the offspring, to the one set of characters of one variety, of another set of characters of another variety. Darwin would be correct, were he to say, that an advantage frequently results from the act of crossing two varieties; for, each generally possesses characters which the other lacks. But, when individuals have the complement of characters, necessary to fertility, they may long continue their breeding without crossing.

The instances, which Darwin cites, of the enclosed flowers, which are incapable of crossing, alone being fertile; and, the instances of other plants of the same species, which are sterile, are fully explicable, upon the theory, that the reason why the enclosed flowers

are fertile, is because they are fully and proportionately developed; while, the reason the unenclosed flowers are sterile, is because, in the feature of enclosure, and most, probably, in other characters, they are deficient. The smallness of the enclosed flowers, is a feature which weighs but little, in the account of fertility, in comparison with disproportionate development. The mere lack of enclosure, would suffice to make an appreciable difference in fertility only after very long continued self-fertilization. But, this lack of enclosure, is doubtless conjoined with other structural defects.

On p. 229, *Animals and Plants, &c.*, Darwin says, as:

"In several well authenticated instances, already often alluded to; certain species have been affected, in a very different manner, for they have become self-impotent, whilst still retaining the capacity of fertilizing, and being fertilized, by distinct species."

Frequently, individuals only, of a species, are modified in character, and have parts reduced to a rudimentary condition. These individuals, of the species, will of course be sterile; while those, individuals of the species, which are unmodified, or very little modified, will preserve their fertility. Of such cases, Darwin really speaks, in the following remarks (page 168, *Animals and Plants, &c.*):

"We now come to cases clearly analogous with those just given, but different, inasmuch as individual plants alone, of a species, are self-impotent. This self-impotence does not depend on the pollen, or ovules, being in a state unfit for fertilization, for both have been found effective, in union with other plants of the

same, or of a distinct species. The fact of these plants having spontaneously acquired so peculiar a constitution, that they can be fertilized more readily by the pollen of a distinct species, than by their own, is remarkable (!) These abnormal cases, as well as the foregoing normal cases, in which certain orchids, for instance, can be much more easily fertilized by the pollen of a distinct species, than by their own, are exactly the reverse of what occurs with all ordinary species (!) For, in these latter, the two sexual elements of the same individual plant, are capable of freely acting on each other; but are so constituted, that they are more or less impotent, when brought into union with the sexual elements of a distinct species, and produce more or less sterile hybrids. It would appear, that the pollen, or ovules, or both, of the individual plants which are in this abnormal state, have been affected in some strange (!) manner, by the conditions to which they themselves or their parents have been exposed; but whilst thus self-sterile, they have retained the capacity, common to most species, of partially fertilizing, and being partially fertilized, by allied forms. However this may be, the subject, to a certain extent, is related to our general conclusion, that good is derived from the act of crossing."

"Conclusion!" The term is a happy one; for his explanation concludes precisely where it begins,—at the very fact to be explained. If, from the fact, that good results from crossing, he deduces, or induces, a *conclusion*, that good results from crossing, how unique, and ingenious, must have been the process of ratiocination, or of induction, by which he effected the transition from the fact to the conclusion!

He makes a passably good guess at the remote cause

of the self-impotence, of these plants, when he says above:

"It would appear, that the pollen or ovules, or both, of the individual plants which are in this abnormal state, have been affected in some strange (!) manner, by the conditions to which they themselves, or their parents have been exposed."

Had he but eliminated the "strange," and the "remarkable" elements from his problem, he would have found, that the conditions were at the bottom of the sterility, through the reduction, or suppression, of certain parts, in the plants, which they effected. This reduction, or suppression (as he would have found), has reduced the number of characters, in each plant so self-impotent, below the complement necessary to give the reproductive elements their needed capacity.

Conformably to this idea, it was to be expected, that, when plants of full reproductive power, were placed under conditions which were adverse to the development of certain of their characters, they would become self-impotent, or abate the measure of their fertility, in proportion as they became so modified in their development. The result is due to the absence of certain chemical elements, &c., necessary to the development of some part, or parts, of the organism. Not only may this be the occasion; but, frequently, of a number of plants, which are comparatively fertile, there are some, placed where the conditions are peculiarly favorable to some one, or more parts only. The proportion of the parts being thereby vitiated, injury results to the reproductive organs; whilst it

does not result, in the other plants, to all of whose parts, the conditions are unfavorable, in the degree in which they are to most of the parts, in the sterile plants just mentioned. Thus, favorable conditions, if favorable only to one part or organ, will often produce loss of fertility. Darwin in the quotation below, notes the sterility of the plants, and sees that the conditions are, in some way, answerable for the results; yet, he cannot imagine the mode, in which the conditions work the effect; but concludes that the sum of the knowable, in this respect, is that the conditions are "*unnatural.*"

He says (p. 218, *Animals and Plants, &c.*):

"Plants, which have been exposed to unnatural conditions, sometimes become modified, in so peculiar a manner, that they are much more fertile, when crossed by a distinct species, than when fertilized by their own pollen."

This explanation, that the "*peculiar*" manner, in which they are modified, is due to conditions being "*unnatural,*" is to the full as satisfactory, and to the full as scientific, as the explanation, that variations are due to "an innate tendency to vary;" or, as the explanation, that it is a "great law of nature," that evil should attend close-interbreeding, and that good should follow crossing.

When plants, such as these which have been in "unnatural conditions," are changed to other conditions, and these other conditions are favorable to the development of the parts which before were reduced or suppressed, a gain in fertility naturally follows.

"Returning to P. alata," says Darwin (p. 170, Vol.

ii, *Animals and Plants, &c.*), "I have received (1866) some interesting details from Mr. Robinson Munro. These plants, including one in England, have already been mentioned, were inveterately sterile, and Mr. Munro informs me of several others, which after repeated trials, during many years, have been found in the same predicament. At some other places (!), however, this species fruits readily, when fertilized with its own pollen."

At these "some other places," it has found the chemical elements, and other conditions of life, which are essential to the development of those of the parts whose loss, or reduction, produced the sterility of the individuals, found in the bad "predicament." Consequently, the development of these parts, with that of the others, secures the fertility, which attains its maximum, only when a full return is made to the original, perfect type.

In different habitats, different plants receive unlike quantities of the gases, liquids, and solids, necessary to their development. The proportion, therefore, of a Plant varies, according to the place to which it is fixed. The soil, in such cases, possesses, generally, some ingredient which is favorable to the development of some one part. In another place, to which the plant may be transplanted, there may be an abundance of the matter required for a certain other part, or for a certain class of its tissues. When so transplanted, it not only derives a benefit, from the development of these latter portions of its organization, but the high development of the other part, may be sustained for a time, through the capacity for assimilating

and making thoroughly available, the ingredient first mentioned, which may or may not be present only in meagre quantities, in its new location. It is therefore, to be expected, that good will be derived from slight changes in the conditions of life.

Under the heading of "On the Good derived from slight Changes in the Condition of Life" (p. 178, Vol. ii, *Animals and Plants, &c.*), Darwin says:

"In considering whether any facts were known, which might throw light on the conclusion arrived at in the last chapter, namely, that benefits ensue from crossing, and that it is a law of nature that all organic beings should occasionally cross, it appeared to me probable, that the good, derived from slight changes in the conditions of life, from being an analogous phenomenon might serve this purpose. No two individuals, and still less no two varieties are absolutely alike, in constitution and structure; and when the germ of one is fertilized by the male element of another, we may believe that it is acted on in a somewhat similar manner as an individual, when exposed to slightly changed conditions. Now, every one must have observed the remarkable influence on convalescents, of a change of residence, and no medical man doubts the truth of this fact. Small farmers, who hold but little land, are convinced that their cattle derive great benefit from a change of pasture. In the case of plants, the evidence is strong that a great advantage is derived from exchanging seeds, tubers, bulbs, and cuttings, from one soil or place to another as different as possible.

"The belief that plants are thus benefited, whether or not well founded, has been frequently maintained from the time of Columella, who wrote shortly after

the Christian era* (*sic!*), to the present day; and it now prevails in England, France, and Germany. A sagacious observer, Bradley, writing in 1724, says, 'When we once become Masters of a good Sort of Seed, we should at least put it into Two or Three Hands, where the Soils and Situations are as different as possible; and every Year, the Parties should change with one another, by which Means, I find the Goodness of the Seed will be maintained for several Years. For Want of this Use, many Farmers have failed in their Crops, been great Losers.' He then gives his own practical experience on this head. A modern writer asserts, 'Nothing can be more clearly established in agriculture, than that the continual growth of any one variety in the same district, makes it liable to deteriorate either in quality or quantity.' Another writer states that he sowed close together, in the same field, two lots of wheat-seed, the product of the same original stock, one of which had been grown on the same land, and the other at a distance, and the difference in favor of the crop from the latter seed was remarkable. A gentleman, in Surrey, who has long made it his business to raise wheat to sell for seed, and who has constantly realized in the market, higher prices than others, assures me that he finds it indispensable continually to change his seed; and that for this purpose, he keeps two farms differing much in soil and elevation."

(Darwin thinks, that the good derived is due to the change, *per se!*)

If, on the other hand, plants are changed to a locality, wanting in some of the conditions, present at the former habitat, and which supplies none of the conditions which may have been absent, or in meagre

* The impression, with the writer, has ever been, that the "Christian era" lasted, *at least*, until the *Origin of Species* was published.

quantity, at the former locality, the plant must, instead of gaining in fertility, become of lessened fertility or sterile; on account of the reduction or suppression of those parts the conditions whereof, are wanting. Such is the case.

Darwin says (p. 182, Vol. ii, *Animals and Plants, &c.*), under the heading of "Sterility from Changed Conditions":

"I will now attempt to show, that animals and plants when removed from their natural (!) conditions, are often rendered in some degree infertile, or completely barren, and this occurs when the conditions have not been greatly changed. It is notorious that many animals, though perfectly tamed, refuse to breed in captivity."

The animals, which refuse to breed in captivity, are those which have been taken from a state of nature, and subjected to close confinement. They are barren, because,—though their new conditions may be incapable of reducing any of their features,—those new conditions are yet capable of suspending the functions of some of the organs, which is next injurious to their being divested of those parts; inasmuch as the absence of this activity, bereaves the respective organs of that influence upon the aggregate, which is essential to the balance of the whole. Consequently, those organs have not their due influence upon that portion of the system, from which the reproductive element is differentiated. This reproductive element is the reflex of the forces of the aggregate, and when the latter is modified, the reproductive power is impaired. Fancy

a monkey, taken from the wild state, wherein he so disported himself as to keep his cerebellum constantly on the *qui vive* in order to coördinate every fibre and muscle in his body; and placed in a cage, three feet by three, where he is constrained to a quiet, modest behavior. If the reproductive element derives its capacity, from the coördination of all the parts, is it any wonder, that the animal refuses to breed? Of course, the conditions of food, of drink, of air, etc., enter into the problem. But, in every aspect of the case, the cause of the sterility resolves itself into the want of perfect coördination of the parts—be those parts suppressed, reduced, or only measurably atrophied; be the reduction in characters, structural, or merely functional.

But, in these cases, where animals, in captivity, refuse to breed, there has often been an actual reduction and suppression of some of the features of the animals; —doubtless due to correlation with those parts constrained to unwonted inactivity. On page 193, Vol. ii, *Animals and Plants, &c.*, Darwin notices many cases, where the sterility of captive animals has been attended with the loss of characters of the individual. He does not discern the relation between the two, but he states the facts as severally existing.

Darwin says (p. 337, Vol. ii, *Animals and Plants, &c.*):

"Slight variations, of many kinds, * * * are retained as long as plants are grown in certain soils, of which Sageret gives, from his own experience, some instances."

If such plants are removed to another soil, wanting

in the conditions necessary to retain such variations; and if, in addition, the new soil is not capable of developing some other characters which the plant has lacked, and which may serve to keep up the complement of developments, necessary to any degree of fertility, the plant will manifestly become sterile.

Darwin says, that, "Any two self-impotent plants can reciprocally fertilize each other." This conclusion of his is supported by an immense array of facts. But, when the cause is known, the said conclusion is seen to be a little too broad. Self-impotent plants can, and generally do, fertilize each other. But, this is, because the plants are somewhat different in structure. Where two self-impotent plants are similarly defective in structure, they cannot fertilize each other. Plants are self-impotent, because they are defective in structure, and because, in the self-impregnation, each reproductive element supplies the forces, of exactly the same number (and no more) of characters, which the other element does. But, when two individual plants, with any positive differences distinguishing them, cross, the reproductive element of each has some positive character or characters to contribute to the formation of the seed, which the other plant has not; and, between the two of them, they make up the forces of the number of parts requisite for successful fertilization. To Darwin, the fact of the capacity of two self-impotent plants to fertilize each other, is simply anomalous.

He says (p. 174, Vol. ii, *Animals and Plants, &c.*):

"It is interesting (!) to observe the graduated series,

from plants which, when fertilized by their own pollen, yield the full number of seeds, but with the seedlings a little dwarfed in stature,—to plants which, when self-fertilized, yield few seeds,—to those which yield none, —and, lastly, to those in which the plant's own pollen and stigma act on each other like poison."

One would presume, that this "graduated series" of effects, instead of being "interesting," would be rather disheartening, to a scientist who had given nearly a half century to the study of plants, without making one step towards a solution which could give a quantitative explanation of these phenomena! His "law of nature" is no explanation—it is a farce, in the light of the many exceptions there are to it, and in the light of this "graduated series." It does not allow such exceptions; it permits no such "graduated series;" nor does it contemplate such infinite variations in the quantity of effect. This "law of nature," of his, is but the formula of the re-statement of an observed general effect. It is an insult to the very name of science to formulate such a "law." His "law of nature" is born of an order of thought, no higher than that which ascribes results to a fetich. It would have been the occasion of little surprise, that Darwin assigned such a "cause," had his acquaintance with the phenomena of lessened fertility, been a meagre one. But, to perpetrate such an absurdity, after noting such a diversity of effects (a diversity, plainly intimating, that a *vera causa* exists, and that it lies within easy reach of discovery, at the recurrence of each variation in the effects), betrays habits of thought of the most slovenly character. Darwin has genius;

but, it is for this, principally: For exalting convertible platitudes into "explanations!"

Darwin, while gazing, contemplatively, upon this "graduated series" of effects, which stands as a monument to his well-nigh phenomenal obtuseness, ejaculates, with all the impressiveness of Pickwick, How "interesting!" It is "interesting" to him (mark), because it is inscrutable.

It may be "interesting," so to indulge a barbarous wonder; to regard phenomena as due to chance, or some innate tendency; and to obviate the incongruities of his theory, by recourse to the proverbial idea that Nature is capricious; but, it should be infinitely more "interesting," to a scientist, to resolve this "graduated series;" to discover the *vera causa* thereof; and to note how this seemingly fortuitous diversity of effects, corresponds most faithfully, in every instance, and degree for degree, to like gradations in the quantity of a given cause. It is more gratifying, by far, to be able to place, side by side with this "graduated series" of effects, a similarly graduated series of departures from a normal type; than, to be lost in dumb wonder, as Darwin is, at phenomena which, with silent eloquence, tell him, who is so fertile in "great laws of nature," to obey the injunction which follows Pope's request to teach Omnipotence how to rule.

A man, of "liberal" ideas, may, when it subserves his purpose, repose with perfect confidence, upon the hypothesis, that there are phenomena which it is never for Man to solve. But, woe betide the unlucky sprite,

tinctured with the faintest trace of orthodoxy, who may have the effrontery to entertain or propound such a view!

When, in times past, before was waged that "fearful Struggle for Existence," of which "Natural Selection" was the outcome, all of the chemical elements and conditions essential to the full and proportionate development of a plant, were adequately supplied; all the features and organs of the plant, were in full and harmonious proportion. When fertilized by its own pollen, its fertility was at its maximum, and the flowers yielded their full number of seeds. When the species became modified,—when parts of the plant became somewhat reduced,—the plant "when fertilized by its own pollen," had its "flowers to yield the full number of seeds, but with the seedlings a little dwarfed;" When the plant, "in the terrible battle of life," had departed further from its primitive, and normal type; when the loss and reduction of parts, became more pronounced, the plant, when self-fertilized, yielded "few seeds;" When the departure from full integrity, grew greater still; when many organs had been reduced to a rudimentary condition; the plant yielded "no seed;" When the degeneration progressed, the reproductive elements found not, represented in them, the forces of that number of characters of the species which was necessary to the reciprocal play of their functions of integration. Self-impotence, then, characterized the plants: When this, or a greater, departure from the original mould had ensued, the reproductive elements, being incapable of any integration whatever, under-

went a retrograde metamorphosis; "the surface of the stigma, in contact with the pollen, and the pollen itself, becoming * * dark brown and then decaying;" When the plant became still more modified, the vigor of the plant was gone; and the individual died. The individuals of each species of plant are at present to be seen in one, several, many, or all of these stages. This is the explanation of the "graduated series." This is more than "interesting:" It is a complete, quantitative solution of all the diverse phenomena.

Speaking of those species, which have but some individuals self-impotent, Darwin says (p. 174, Vol. ii, *Animals and Plants, &c.*):

"This peculiar state of the reproductive organs, when occurring in certain individuals alone, is evidently abnormal."

What a wealth of knowledge, is here conveyed. He can but mean, that exceptions to the general rule for a given species, are (*sic*) evidently exceptions! He cannot intend anything else; for, he is precluded from using the words "normal," and "abnormal" in any other sense, by his theory, viz., that there is no fixed *status*, for any organisms, because the law of their development is constant change. The above, is but another of his re-statements of what he affects to explain.

The self-impotence, of which he speaks, and all cases of sterility and of lessened fertility, are abnormal. It matters not, whether they occur in certain individuals alone, of a species; or whether they occur in all of the individuals of a species. It is not the

fact, that they contravene an observed, general result, which makes them abnormal (although it does in one sense; but that sense is so obvious, that no one, unless he was solicitous to give an impression that he was not passing by facts without *explaining* them, would ever think of imparting what it needs no ghost, come from his grave, to tell). They are abnormal, by reason of the fact, that they prevail, only when there is a breach of the true coördination of the characters of the given species. "This peculiar state of the reproductive organs," is the consequence of the absence, or reduction of characters; which, also, is abnormal. It is the penalty, entailed upon the organisms, for their departures from the true integrity of their respective species.

Referring to the self-impotence of many plants, Darwin remarks (p. 111, *Origin of Species*):

"How strange are these facts! How strange, that the pollen and stigmatic surface of the same flower, though placed so close together, as if for the very purpose of self-fertilization, should, in so many cases, be mutually useless to each other. How simple are these facts explained, on the view of an occasional cross with a distinct individual, being advantageous or indispensable!"

"How simple?" aye, how idiotic! to *explain*, that the cause of the bane, is the existence of the antidote! We are lost in wonder, at this evidence of how great an amount of cerebral phosphorus, some of these highly-developed Quadrumana may secrete.

To paraphrase Darwin's statement: Men frequently fall sick; "How strange are these facts! How simple

are these facts *explained*, on the view of an occasional" dose of medicine "being advantageous or indispensable!"

Darwin, in striving to explain the causes of the lessened fertility of plants, essays the very ingenious surmise, that "their sexual functions are disturbed." But, it is to be remarked, that he gives not the remotest approach to a conjecture, as to what is the reason for this disturbance; how it is brought about; nor why the disturbance is absent in one case, is great in another, is less in a third, and but slight in a fourth. He says, respecting these phenomena (p. 231, Vol. ii, *Animals and Plants, &c.*):

"We are far from knowing the cause; nor is this surprising, seeing how profoundly ignorant we are in regard to the normal and abnormal action of the reproductive organs."

It has been shown, with respect to animals, that varieties are generally incapable of long continuing the same form; that, unless crossing is resorted to,—which varies the form,—or reversion occurs in some of the parts, such varieties die out, and give place to others; owing to the evil effects resulting from their incomplete, or disproportionate development. The same holds good, with plants. Varieties, either die out altogether, after a time, or they vary somewhat their form. To this principle, is due the degeneration which, as Darwin has shown, requires that there should be frequent exchanges of seed, or change of conditions. A variety which long remains "genuine," may be relied upon, as being comparatively propor-

tionately developed. The evils which result to plants from disproportionate development, are encouraged by the process which planters have of "roguing" (*i. e.*, weeding out) those individuals, of a variety, which depart from the type prescribed by their owners. Darwin says (p. 34, *Origin of Species*):

"When a race of Plants is pretty well established, the seed-raisers do not pick out the best plants, but merely go over their seed-beds, and pull up the 'rogues,' as they call the plants that deviate from the proper standard."

As this "proper standard," generally requires the monstrous development of some one character only (that character, which is valued); and suffers, or has compelled, the reduction of other characters to a rudimentary condition; it is impossible for the plants, long to continue their kind. To remain constant long, to a a given type; either that type must approximate the sum of all the positive characters of its species; or it must deviate from such "proper standard," by abating the abnormally developed part; by increasing the development of one or more of the other (*i. e.*, the not valued) parts; or by restoring some of the parts which were wholly suppressed or rudimentary; or it must supply some of these defects of structure by crossing with individuals of another variety.

So imperative is this alternative, of either extinction, or change of form, where plants are defective in structure, that Darwin comments upon it, with some surprise. The change of form is effected, generally, unconsciously to man. For, those plants which persist

in a varietal type which is of defective structure, become of lessened fertility, and of lessened vigor. These, man, for obvious reasons, rejects; and selects those which are hardier and most fertile. The latter owe this vigor and fertility to such slight successive increments of growth in various parts, that the change escapes man's eyes, until he awakes, with surprise, to the fact of how different the variety is, to what it was but a few years back! He himself has occasioned it, by his selection of the strongest and most fertile. Then; it is very difficult to confine a plant to a given type, when its seed is distributed and grown in many places, where the supplies of the conditions of growth, are so different. A variety is, very frequently the outcome both of man's selection, and of a given set of conditions. Where this set of conditions, is not realized, all of man's care cannot prevent a change of form, in the transplanted variety.

"De Candolle," says he (p. 513, *Origin of Species*), "has fully discussed the antiquity of various races of plants."

He then speaks of old varieties of the poppy, of the almond, of the cabbage, of the turnip, &c., which existed, many centuries back, and which are measurably like the varieties existing at the present day.

"But," says he, "it does not seem improbable, that some of these varieties may have been lost and reappeared;" and "whether any of these plants are absolutely identical with our present sub-varieties, is not certain."

Respecting the changes of form, which are required

to save varieties from extinction, the following assertion of Darwin may be quoted:

"Whether," says he (p. 397, Vol. i, *Animals and Plants, &c.*), "the incessant supply of new varieties, is partly due to * * occasional and accidental crosses, and their fleeting existence to changes of fashion; or, again whether the varieties which arise after a long course of continued self-fertilization, are weakly and soon perish, I cannot even conjecture."

The doubt, in his mind, as to their becoming weakly, and perishing, arises probably from the fact, of his having observed several varieties which,—being proportionately developed,—contravene his incomplete induction.

The loss, or reduction, of characters, entails loss of fertility. This fertility may be regained by the restoration of such lost or reduced characters. It matters not, by what process is effected the addition of characters to a defective variety, to make up the complement necessary to induce fertility, or increase of fertility. If the result be attained by direct reversion (*i. e.*, by what is called improvement), the fertility ensues: If by crossing, the same gain follows. Even when a measurable return to perfect type, is secured by that addition of characters, which is effected by splicing two varieties together, in Grafting, the good equally results.

As Darwin remarks (p. 12, *Origin of Species*):

"It is really surprising, to note the endless points in structure, and constitution, in which the varieties and sub-varieties," ("of some of our cultivated plants as the" varieties of the "hyacinth, potato, even the

dahlia," &c.), "differ slightly from each other. The whole organization seems to have become plastic and tends to depart, in some small degree, from the parental type."

Each variety has some positive peculiarity, which is wanting in all the other varieties of the same species, and the absence of which, lessens the capacity of those varieties, for reproduction. A plant, lacking many, and important features will, as has been shown, have its reproductive elements wholly incapacitated for union with each other, or for union with the sexual elements of other plants of exactly the same mould; and yet, the plant will be quite fertile, with other individuals of the species, with forms dissimilar. The reason is; in the former cases, the reproductive elements cannot build a structure, when each lacks so many, and the same, materials. In the latter case, they may build (though each lacks many of the materials), if both make up, with the forces of what characters they have, all, or most, of what is needed. To be functionally perfect, an organism must be, of the full structural integrity, of its species. Man may mould the individuals, of a species, into a multitude of shapes; but each such form (save one), will, of necessity, be in derogation, both of its structural, and of its functional perfection. In such a way, the whole organization may be shown to be "plastic;" but, plastic, in much the same manner a man may be shown to be, by cutting off his leg. May a truncated crystal, with an edge lopped off, be rightly said to be plastic? Or, may a number of such truncated crystals, be said to be plastic, merely because it is possible to

arrest each crystal, at a different stage, in its process of reintegrating its lost edge?

Of the three processes, by which lessened fertility is regained, reversion by means of slight accretions of growth, is one. The evidence from Darwin, on this point,—namely, of increased fertility, concomitant upon the development of structure by means directly of Reversion,—is not abundant; for two reasons. The one is, that Darwin, not being conscious,—or seeming not to be,—of the connection between the two, has not made it a subject of close observation; and, direct Reversion, not being abrupt, as Reversion, of course, is in Crossing, the resulting gain, in fertility, has just been noticed by Darwin, and left without further remark.

He says (p. 212, Vol. ii, *Animals and Plants, &c.*):

"Domestication, as a general rule, increases the prolificness of animals and plants."

Another reason is, that the gain, in fertility, which should ensue from the improvement, or reversion, occurring under domestication, is quite frequently precluded by man's vitiating the proportion, through pushing the development of one or two characters only, to an extreme point. This, as we have before frequently observed, is often worse, in its effects, than was the comparatively uniform degeneration which obtained, before Man bestowed care upon the individuals. Another reason is that Man suppresses and reduces organs, as he has done with the Pig. These are the reasons, why the result required by the theory of reversion, and noticed by Darwin, obtains, as he says, "as a general rule" only.

On the other hand, as Darwin says (p. 144, Vol. ii, *Animals and Plants, &c.*):

"The benefit from a cross, even when there has not been any very close-interbreeding, is almost invariably at once conspicuous."

In the chapters, on Pigeons and Fowls, it will be remembered, that Darwin says, what he repeats, and reiterates in one form, or another, again and again, throughout his works; that:

"The more distinct the breeds, that are crossed, the more fertile, the mongrel offspring." Below, he notices the exceptional excellence of mongrel plants "'of which, the parents were the two most dissimilar varieties, I could select.'"

It will be noticed, that the gardener erroneously terms mongrels, "hybrids;" a fault which Darwin corrects. The other term, "hybridizations," Darwin doubtless thought it needless to rectify.

"With respect to the benefit, derived from crossing distinct varieties" (Vol. ii, p. 160, *Animals and Plants, &c.*), "plenty of evidence has been published; Sageret speaks, in strong terms, of the vigor of melons raised by crossing different varieties, and adds, that they are more easily fertilized than common melons, and produce numerous good seed. Here follows the evidence of an English gardener. 'I have, this summer, met with better success, in my cultivation of melons, in an unprotected state, from the seeds of hybrids (*i. e.*, mongrels), obtained by cross-impregnation, than with old varieties. The offspring of these different hybridizations (?) (one, more especially, of which the parents were the two most dissimilar (!) varieties I could select), each yielded more ample and finer produce than any-

one, of between twenty, and thirty established varieties.'"

The mongrels, from a cross between "the two most dissimilar varieties I could select," were remarkably excellent, because the amount of positive differences, is generally greatest, with individuals, or varieties, the most dissimilar; for, the union of the characters which constitute these differences, in the mongrels, secures a great remove, towards the original, perfect type. Each of these varieties, therefore, had much to contribute, which the other lacked. Here, with the varieties of the melon, as with the varieties of all cultivated species, the excellences, which should be compounded, or united, in each individual, of the species, are frittered away, by apportioning them among different individuals and varieties. Hence; the evil effects, which are attendant upon the close-interbreeding and the self-fertilization of the individuals of each variety, which lacks the special excellences of all the other varieties. Hence; the good from Crossing, which remedies such apportionment, by uniting the special excellences, or other positive, peculiar characters, of two varieties, in the one individual, the offspring.

Again he says:

"Andrew Knight believed that his seedlings, from crossed varieties of the Apple, exhibited increased vigor, and luxuriance; and, M. Chevreul alludes to the extreme vigor of some of the crossed fruit trees, raised by Sageret."

"By crossing, reciprocally, the tallest and shortest peas, Knight says, 'I had, in this experiment, a strik-

ing instance of the stimulating effects of crossing the breeds; for, the smallest variety, whose height rarely exceeded two feet, was increased to six feet; whilst the height of the large and luxuriant kind, was very little diminished.' "

The offspring was not diminished, or increased, to a mere mean, between the two varieties which were, respectively, large and small; because the capacity for reversion to the greater height, lay ready to be exercised, in the smaller variety; and, doubtless, the latter also made amends, for its small size, by contributing some positive differences, in some of its characters, in which the large variety was deficient. For, the accession of new characters, always,—or nearly always,—brings with it increased size; due, both to the capacity for reversion, and to the room which this accession demands. Crossing, Darwin asserts, increases the size; though, the fact belongs only to his voluminous repertory of things which are "strange," "wonderful," "remarkable," "peculiar," etc., and which obey an "innate tendency." Darwin's *forte* lies in facts; his explanatory sagacity he seems to have exhausted, in devising his "innate tendency," and his "great law of nature." Those explanations (?) contain, within them, the very quintessence of the absurd; but, it is no paradox to assert, that there is ever a greater expenditure of cerebral phosphorus, involved in the conception and application of a fallacious doctrine, than there is, in the discovery of the grandest truths. The hard attrition, of each fact, against the fallacy, is most wearing to the brain; whereas, a true principle

evolves itself most gracefully, and courses with perfect ease, in and out, among all of the phenomena.

Continuing, Darwin remarks:

"Mr. Laxton gave me seed-peas, produced from crosses between four distinct kinds; and the plants, thus raised, were extraordinarily vigorous, being in each case, from one to two or three feet, taller than the parent forms growing close along side of them."

On page 161, Vol. ii, *Animals and Plants, &c.*, he says:

"Weigmann made many crosses between several varieties of cabbage; and he speaks with astonishment, of the vigor and height of the mongrels, which excited the amazement of all the gardeners who beheld them. Mr. Chaundry raised a great number of mongrels, by planting together six distinct varieties of cabbage. These mongrels displayed an infinite diversity of character; but the most remarkable circumstance was, that, while all the other cabbages and borecoles, in the nursery, were destroyed by a severe winter, these hybrids (?) were little injured, and supplied the kitchen, when there was no other cabbage to be had."

The height, which was observed in these mongrel cabbages, was due, doubtless, to reversion in the stock which, according to Darwin, in some individuals, has attained an enormous height.

"In the Island of Jersey," says he (p. 389, Vol. i, *Animals and Plants, &c.*), "from the effects of particular culture, and of climate, a stalk has grown to the height of sixteen feet, and 'had its spring shoots, at the top, occupied by a magpie's nest;' the woody stems are not unfrequently, from ten to twelve feet in height, and are there used, as rafters, and as walking sticks."

The great room, for improvement, there is in the cabbage, by means of reversion direct, or reversion by crossing, is here shown (although no useful purpose of Man will be served by effecting such improvement in the said plant); and the "infinite diversity of character," which Darwin notes, is explained, by the fact, that many of the characters of the cabbage species, have been distributed among the different varieties. The above quotation shows one feature, in which most of the varieties have been modified. "Every one," says Darwin, "knows how greatly the various kinds of cabbage, differ in appearance." He then notices the height the plant has attained in the Island of Jersey, and gives many of the forms which the cabbage has assumed, in several parts of the world.

On page 281, Vol. ii, he says, "No variety of wheat is quite uniform, in character." This shows, that, not only do the varieties of wheat differ in character, but so, also, do the individuals of each variety. His observation has doubtless been confined, to the part which man values, viz., the seed; but, together with variations, in the special excellence of that species, there are, also, many variations in the leaves, in the stalks, and in other not-valued parts. When these positive differences are united, in an individual plant, as they are, by crossing, good must, according to the theory of reversion, result. The facts consist with this inference.

"Mr. Maund," says Darwin (p. 161, Vol. ii, *Animals and Plants, &c.*), "exhibited before the Royal Agricultural Society specimens of crossed wheat, together

with their parent varieties, and the editor states, that they were intermediate in character, 'united with that greater vigor of growth, which, it appears, in the vegetable, as in the animal world, is the result of a first cross.' Knight also crossed several varieties of wheat, and he says, 'that in the years 1795 and 1796, when almost the whole crop of corn, in the island, was blighted, the varieties thus obtained, and these only, escaped in this neighborhood, though sown in several different soils and situations.'"

On page 281, Vol. ii, *Animals and Plants, &c.*, he says:

"The straw of the Fenton wheat, is remarkably unequal in height; and, a competent observer believes, that this variety is highly productive, partly because the ears, from being distributed, at various heights, above the ground, are less crowded together."

Doubtless, to this is due some of the effect; but, it is probable, that, with the inequality in height, there is a diversity in the quality of the different classes of tissues, in the proportion of the chemicals assimilated, and in others of the characters; and, that the fertility arises from the interbreeding of the individuals, which is, under the circumstances, tantamount to crossing.

It may be asked, by the reader, unacquainted with the motives which govern seed-growers, in their selection; Why, if such great increase in vigor, size, fertility, &c., is secured by crossing, is not that process generally resorted to? The reason is, that the improvement of the plants is but a secondary consideration, with planters. Their first aim is, to secure uniformity of character, in the individuals of each variety, and this end is frustrated by crossing. Upon a cross,

each of the mongrels starts out, in a different direction, towards the perfect type of its species, and there is but little chance, if crossing be continued, of ever getting them uniform again, until they attain their goal. The case, where the mongrels may be made uniform, is unique.

On p. 121, Vol. ii, *Animals and Plants, &c.*, Darwin says:

"The history of a variety of wheat, which was raised from two very distinct varieties, and which, after six years' culture, presented an even sample, has been recorded on good authority."

In this case, the wheat must have been grown for those six years upon the same piece of ground. In no other way, could they have been brought under subjection.

Planters are jealous of the development, in their plants, of any characters other than the special excellence. They even grudge other characters, the chemical elements, and even the carbonic acid of the atmosphere, which are needful for their growth. The prejudice they entertain, respecting a cross (which starts the development of all the characters of the plant), may, therefore, be appreciated. Planters have never had more than two ideas, on the subject of the cultivation of Plants, namely, Selection, and "Fertilizers;" despite the fact that every plant, under their care has ever been vocal, with the cry, that the true *Fertilizer* is proportionate development. Full, proportionate development may, at times, not consist with the profit of the planter; but that degree of proportionate

development, which is requisite to stave off sterility, and lessened fertility, is an important item in cultivation.

Darwin says (p. 505, Vol. ii, *Animals and Plants, &c.*):

"I have just said, that the crossed offspring would gain in vigor and fertility. From the facts given in the xviith chapter, there can be no doubt of this; and there can be little doubt * * that long-continued, close-interbreeding leads to evil results. From these various considerations, the conclusion, arrived at in the chapter just referred to,—namely, that great good of some kind, is derived from the sexual concourse of distinct individuals,—must be admitted."

What a brilliant and satisfying conclusion to come to! With what admiration must his readers regard him, thus:

> "* * boldly soaring, in sublimer mood,
> Through trackless skies, on metaphysic wings."

With what a hush of profoundest awe, must his disciples here contemplate their master, who has just proved that he is capable of discovering, that, in a congeries of effects,—varying, too infinitely in quantity,—there is at work, some mysterious law! Good is observed to recur, at times, from crossing: Then, the scientist (this scientist, *par excellence*) frames a "great law of nature," viz., that good recurs! Truly, the following tribute should be paid, to Darwin's genius, as it was to that of his grandfather, the author of "*Loves of the Plants*":

"Willing Nature to thy curious eye,
Involved in night, her mazy depths betray."
* * * * * *
"And Nature in primordial beauty seems
To breathe, inspired by thee, THE PHILOSOPHIC SOUL!"*

Again does Darwin say (p. 175, Vol. ii, *Animals and Plants, &c.*):

"These facts all point to the same general conclusion, namely, that good is derived from a cross between individuals which, either innately (*sic*), or from exposure to dissimilar conditions, have come to differ in sexual constitution."

Why, (1) good should be derived from a cross; (2) what this "innate" tendency is, which causes the individuals to differ in sexual constitution; (3) What are these differences in sexual constitution; (4) and Why exposure to dissimilar conditions produces these sexual differences, are conundrums which are not solved upon Darwin's theory, doubtless because it was deemed that to attempt their solution would be in derogation of the respect due to "a great law of nature."

Darwin is mistaken, not only when he refers the phenomena to "a great law of nature," but also when he contends, that the good from crossing, has any necessary connection with any sexual features, or sexual constitution. The good accrues, whenever there is an increase of the number of characters of the individual,

*These chaste effusions, by admiring friends of Dr. Erasmus Darwin, are to be found incorporated within an edition of the latter's "*Botanic Garden.*" It is to be regretted, that those works of the imagination, "*The Origin of Species,*" and "*Animals and Plants under Domestication,*" which are much superior, in poetical merit, to "*The Loves of the Plants,*" were not also set to metre.

however such increase may be wrought. In Grafting, the condition is supplied, and the good results; and, there, the element of sex, and that of reproduction, are wanting. Each variety possesses some peculiar or other feature which it is necessary, for perfect physiological integrity, that the others should have. The fact of the good results being occasioned also by the process of Grafting, is strikingly out of harmony with his idea, of the good being due to some quality, resident in the sexual organs. Crossing is not the cause, but merely one of the occasions, of the good. The ultimate reason of the good effects, is, that the union, or addition, of characters, supplies a deficient integrity, and brings the individual receiving such an accession of features, back to the type, from which it should never have departed. As frequently remarked, difference, *per se*, is not the cause; the beneficial effect is wrought, only when there is some positive difference capable of covering, or of supplying, a deficiency.

Darwin says (p. 174, Vol. ii., *Animals and Plants, &c.*):

"The self-impotent *Passiflora alata*, which recovered its self-fertility, after having been grafted on a distinct stock, shows how small a change is sufficient to act powerfully on the reproductive system."

This case of the self-impotent Passiflora *alata* becoming again capable of self-fertilization, shows clearly that no matter how the lost integrity of an individual, is repaired; or how the individual regains the characters, lost by itself, or by its ancestors, the recompense, due a return to the original type, is always paid.

The above quotation reveals another of his ingenious

fallacies. By introducing the remark, that the grafting acts powerfully on the reproductive system, he wishes to insinuate the idea that the phenomena incident to grafting, are not inconsistent with the view he previously propounded, to wit, that the good from crossing is due to some peculiarity in the sexual constitution. The fallacy lies in this, that in either of his two propositions, cause and effect are transposed, when compared with the relation the good effects and their cause bore to each other in the other proposition. His first proposition is to the effect that some peculiarity in the sexual constitution is the cause, and the good observed is the effect. His latter proposition, however, is to the effect that the good observed is the cause, and the peculiarity in the sexual constitution is the effect!

On page 437, Vol. ii., *Animals and Plants, &c.*, he speaks of the "facts which render it, to a certain degree probable, that when the tissues of two plants, belonging to distinct varieties, are intimately united," in Grafting, "the characters of the two forms are united."

On page 180, Vol. ii, *Animals and Plants, &c.*, he gives many instances of the good derived from Grafting.

It is a matter, of supreme consequence, to understand the reason of the lessened fertility, and of the sterility, among individuals of the same species; for, it is by the test of sterility, that botanists determine what are and what are not species. Where this is not the test, with them, structural difference is; and the consequence has been, that the classification of species of plants is most absurd. How can they safely make sterility, *per se*, a

test, when individuals of the same species are frequently sterile with each other! How safely make structural difference, *per se*, a test, when there are many cultivated varieties, and many natural races, of the same species, distinguished from each other, by differences, greater than those which mark even genera from each other! It has been popular faith in this idea, of mere structural difference, which has hitherto secured Darwin's theory against confutation. As soon as the idea is broached, that structural difference is of little account, compared with physiological difference, the main stay of his theory is gone.

The result of the test of structural difference, and of the ignorant application of the test of sterility, has been, to make the science of classification, chaos worse confounded. The true test, of a species of plant, is the capacity for long-continued self-fertilization, without abatement in fertility, vigor, or size. All plants capable of indefinitely-continued reproduction with one capable of such self-fertilization, belong to the same species, however structurally different such plants may be. Each plant, which is self-impotent, or of lessened fertility, falls short of the full structure of the species. Plants, of the same, and plants of different species, may be discriminated, by breeding them each with another. If they are capable of long-continued fertilization, they are of the same species. If, however, they are sterile with each other, it is not conclusive evidence of their being of distinct species. For, that may occur with individuals of the same species; in fact, those most alike in structure, if wanting in any

character, will be generally, the most liable to sterility, *inter se.*

Agriculturists, and horticulturists, with Plants, and breeders, and fanciers, with animals, may count confidently upon an individual being susceptible of improvement, or of increase in structure, whenever such individual suffers any loss of vigor or fertility when self-fertilized, or when closely interbred. The margin of improvement, still possible, will be susceptible of ascertainment, by noting the degree of the evil resulting from (say) the animal mating with one of its own kind; or, if it be a plant, from the degree of evil resulting from its self-impregnation. If it be a plant, and it be self-impotent, it will ever be found, either that it has many organs, in a rudimentary condition; or, that some one organ has become extraordinarily dominant. In estimating, however, whether a plant with perfect, or but little impaired fertility, is fully and proportionately developed, or nearly so, security must be had against such possible crossing with other varieties, or with other individuals, as may be effected through the agency of bees, and other insects. If, however, there are no varieties, or individuals of the same species, which have any positive differences distinguishing them from the given individual, it may be safely concluded, that the full fertility and vigor of the individual, truly imply its full and proportionate development; for, if those varieties, with which it is possible for it to cross, have no points of structure, other than those also possessed by the individual in question; it is clear, that the fertility cannot be due to crossing. There is

still another consideration, which obtains, in connection with this subject. A plant may be very degenerate in structure; possess very many organs in a rudimentary condition; may not have crossed with another variety of the same species; and yet such plant may be, at least for one generation, very fertile and vigorous. Such conditions would well consist with a state of facts, where the plant had been crossed by an individual of a distinct, but allied species. It is frequently possible, as Darwin shows, for an individual which is wholly self-impotent, to cross with a distinct species, and be very prolific.

On page 297, *Origin of Species*, Darwin says, that he is led:

"To refer to a most singular fact, namely, that there are individual plants, of a certain species of Lobelia, and of some other genera, which can be far more easily fertilized by the pollen of another, and distinct species, than by their own pollen. * * For these species (Lobelia and Hippeastrum) have been found to yield seed to the pollen of a distinct species, though quite sterile with their own pollen, notwithstanding that their own pollen was found to be perfectly good, for it fertilized distinct species."

It may be asked: is the fertility and vigor acquired, for one generation, by a cross with a distinct species, due to a return to the perfect type? In a measure, or, *sub modo*, it is. It is not, however, a perfect type common to both species. The reason, why fertilization may be effected, for one generation, by the pollen of a distinct species, is because, in the reproductive element of the foreign, but allied species, the given individual

finds many characters, either like its own, and with which its characters may isochronize; or (as in the case given above, where the plant was self-impotent), like the characters, of its species, which it has lost, and which fail to be represented in its own pollen.

With the characters of another species, it may, for one generation, make up its lost integrity. But, the escape of the line of such individuals from extinction, by means of crossing with a distinct species, is only a temporary and slightly deferred one. For, on account of such a cross, their hybrids become irremediably sterile. Had the individual crossed with one of its species, it might have continued indefinitely fertile. The sterility of an individual, whose ancestors have never been crossed with a different species, is not absolute. All that makes such individual sterile, is the loss or reduction of characters; which may be remedied, and the fertility of the individual restored, either by reversion, crossing with an individual of the same species, differing positively in structure, or by grafting. But, when a cross is had with a distinct species, a definite, and inevitable failure of issue, is entailed upon the offspring. There exists a barrier to further reproduction. When two individuals of different species cross, the reproductive element of each is capable of the process of integration, because such element has been normally secreted by a pure species! If the forces of such element, are isochronous with the forces of the other reproductive element, as is the fact generally in the case of closely allied species, the two may concur in building up an organism. But, though the forces

of each element are not so far wanting in rhythmical harmony as to prevent such a coördination as is required for the production of a hybrid, yet that hybrid has in it the characters of the two species, so compounded or coalesced as to preclude its possession of the power of spontaneously exuding a new organism; or in other words, of impressing its coördinating force upon a part of itself, so as to make such part capable of reproducing a likeness of itself.

This is the reason of the good resulting from a cross with a distinct, but allied species, viz.: The plant, in question, is wanting in some of the characters of its species. In the distinct species, it finds characters, like those which are wanting in itself; and, it is possible for it to avail itself of them to amend its lost integrity. But, the line of descent is not capable of being carried any further; and, there is no means possible of averting the extinction which occurs in the succeeding generation, as there is, when an individual of a pure species, becomes self-impotent, or sterile. Two self-impotent individuals of the same species, may be fertile together; and they are fertile, because they have made up, together, the complement of the characters necessary for reproduction; but they are different from distinct species, for these characters are perfectly in harmony with each other, when joined in the mongrel; and, therefore, there is no impediment to the offspring, and its line, continuing indefinitely fertile. All such offspring need do, to continue the fertility, is to keep up the requisite number and proportion of the characters of its species.

To the theory of the necessity for the full and proportionate development of all the characters of a species, it might possibly be objected that the law of Compensation, propounded by Gœthe and the elder Geoffroy, shows that "in order to spend on one side, nature is forced to economize on the other side." Darwin says, respecting this law of balancement of growth, "I think this holds true to a certain extent with our domestic productions;" but doubts the universality of the rule.

The fact is, that the rule holds good only where the organism is impoverished; where, either, it is denied food, chemical elements, &c., in amount sufficient for the needs of all parts of the system; or, where having them to hand, it lacks the capacity for assimilating enough for all of its parts. In either case, the reduction of some parts will benefit the growth of other parts of the organism.

This interpretation, however, is not needed to obviate the objection to the theory of full and proportionate development of all the parts, being necessary to perfection; for, even when by economy on the one side of an organism, an impulse is given to the growth of the other part, physiological injury accrues in proportion to the extent to which the normal ratio of the characters has been vitiated. Quite frequently, by keeping down the growth of some of the parts of a plant, other parts,—say, the reproductive organs, the reproductive elements, and the fruit thereof,—will be greatly augmented in structure. But, this augmentation in structure, even in such parts, will lessen the fertility

and vigor of the organism instead of enhancing them; because such growth violates the proportion. Thus, you may cut away the leaves in a plant, and thereby much increase the size of the seed, but the seed will have its vitality lessened, instead of increased, by augmentation in size, so occasioned.

Fertilization of Orchids.

In this connection, it may be well to notice Darwin's work, on the Fertilization of Orchids, which was written, with the design to prove the truth of his "general law of nature," that evil results from close-interbreeding, *per se*, and from self-fertilization, *per se*, and that a cross with another individual or variety, is absolutely necessary.

This "law," Darwin, as we have shown, promulgated first, in his Origin of Species. Of course, his "law" was demurred to, by every breeder and fancier, horticulturist and agriculturist, who knew of the great variation in the quantity of the effects of interbreeding, and of fertilization; and, who had noted, that, frequently, there resulted no evil whatever from such a process.

Darwin says, on page 1, of the *Fertilization of Orchids:*

"Having been blamed for propounding this doctrine, without giving ample facts, for which I had not in that work (*Origin of Species*) sufficient space, I wished to show that I have not spoken without having gone into details. I have been led to publish this little treatise, separately, as it has become inconveniently large to be incorporated with the rest of the discussion on the same subject."

In this work, he shows that many of the species of Orchids, are incapable of self-fertilization, and are compelled to be fertilized by means of insect agency, to which the structure of the flower, is very elaborately adapted. His argument is, that as these plants are mechanically incapable of self-fertilization, and as the contrivances of the flowers so manifestly subserve insect agency, it follows, that there must be something radically injurious in the process of self-fertilization; and that an advantage is derived from a cross, with a distinct flower. The whole argument presses upon the fact, that the flowers are incapable of self-fertilization. The adaptation to insect agency exists in other flowers, which are able to fertilize themselves; and, with these, no presumption therefore arises, that there is a necessity for the cross which insects effect.

But, the whole significance of his facts, is taken away, when it is observed, that the original form of the flowers, and of the plants, has been modified, in a number of ways; that many characters, as he shows, have been reduced to a rudimentary condition, and that the incapacity for self-fertilization (which is a mechanical, or structural incapacity, and not a physiological incapacity) has arisen (as may be shown, by analogy with the forms of other species of the same genus), from the reproductive organs, of the plants, having become partially rudimentary in structure. The whole structure, of the flowers (barring, the slightest, possible modification), is consistent with adaptation to self-fertilization, as well as to insect agency. The only detail wanting, is but a little more

efficiency in the working of the mechanism. The pollen-mass does not slip, of itself, from the anther-cells but requires force, *ab extra*, to be torn therefrom. *Were the anther-cells and the pollen-mass to proceed a little further in their development, so as naturally to disengage the latter from the meshes of the former*, the flower could well be self-fertilized, by means of the very beautiful adaptations which facilitate the action of insects.

Now, this is the case with one of the species of Orchids, and such species, so self-fertilized, is exceptionally fertile and vigorous!

"Robert Brown," says Darwin (p. 65, "*Fertilization of Orchids*"), "first observed that the structure of the Bee Ophrys is adapted for self-fertilization. When we consider the unusual and perfectly adapted length, as well as the remarkable thinness, of the caudicles of the pollinia; when we see that the anther-cells naturally open, and that the masses of pollen, from their weight, slowly fall down to the exact level of the stigmatic surface, and are there made to vibrate to and fro by the slightest breath of wind, till the stigma is struck; it is impossible to doubt, that these points of structure and function, which occur in no other British Orchid, are specially adapted for self-fertilization."

Now, although the different species of Orchids have certain specific differences of structure, they were originally all capable of self-fertilization; and it has been but a slight modification of their structure, which has deprived them of such capacity. Did space permit, it would be possible, to take up each species, and point out the modification mentioned. In the first species, mentioned by Darwin, the failure of the flowers to

fertilize themselves is due to the anther-cells lacking the power to open naturally, and to the consequent inability of the pollen-mass to release itself and fall to the level of the stigmatic surface. The modification is very slight. It is simply a case of slightly arrested development of the pollen-mass, and of the anther-cells where they cohere. And, as to the possibility of the modification's having been induced; Darwin shows (chap. vii) that, many great modifications have occurred, in almost every individual of this genus, in many and important characters.

Robert Brown, who "first observed that the structure of the Bee Ophrys is adapted for self-fertilization," "believed" (though "erroneously," as Darwin contends), "that this peculiarity (of self-fertilization) was common to the genus." Darwin's only answer to this induction of Mr. Brown, is, that "this one alone of the four species" of British Orchids, shows this capacity. But, this is no objection, as the assumption is, that the other species originally fertilized themselves, and subsequently becoming modified, thus lost the power so to do.

The test, by which to ascertain, whether they have so become modified, and by which to ascertain whether the process of fertilization, *per se*, is injurious, is to be found in a comparison of the fertility of the self-fertilized plants, with the fertility of those which depend, for their reproduction, upon the crossing which is effected by insect agency. The test is the fairest possible; for, Darwin's principal criterion, by which to judge of the injurious effects wrought by self-fertilization, or by

close-interbreeding, has ever been (in his "*Origin of Species*," and in his "*Animals and Plants under Domestication*") the lessened fertility, or the sterility, of the individuals so impregnated. And, the test is also that, required by the theory of reversion. Such theory, of Reversion, maintains, that, where there is little, or no modification, there are no, or very little evil effects occasioned by the process, in question. If, then, there is, in some of the Orchids, the modification which entails the mechanical incapacity for self-fertilization; and, if there is an absence, of such modification, in others of the Orchids, the test of fertility—which is the test with either theory—should, upon Darwin's theory, show that the modified plants (which are ever crossed) are superior, in fertility, to the plants capable of self-fertilization; whereas, upon the theory of reversion, or proportionate development, it should show, that it is the less modified plants (which, in this case, are the self-fertilized ones) which are more fertile than the ones which are crossed, and which have parts which are structurally and functionally rudimentary.

Darwin, as above remarked, has, in his works to which this "*Fertilization of Orchids*" is merely supplementary, clearly defined what he means, by the evil effects of the process of close-breeding. He there ever states, and states explicitly, that those effects are, principally, lessened fertility, and sterility. In all of the phenomena, adduced in his former works, his test has not, to his mind, conclusively failed him. With the light, derived from the theory of reversion, the phenomena mentioned may be proved (as already shown),

to confound, completely, all of his views. But, evil has, in the main, been shown (however much it has varied in character), to be, in some way, occasioned by close-interbreeding. In those instances, even, where good has resulted, the gratuitous supposition has ever appeared open to him that, if the interbreeding were only continued long enough, the evil would manifest itself. And, his "law" has had a semblance of support from the good resulting from crossing; because, each crossed variety had some feature, to contribute to the offspring. Consequently, he has hitherto been pleased and satisfied with the test of lessened fertility, and of sterility.

He finds, however, that the crucial test—admissible on both theories—reveals, that, with Orchids, *the self-fertilized plants are much more fertile, than the crossed plants!* Such a result is the very antithesis to what Darwin's theory requires, and fully refutes his "great law." The reason, to the reader, is plain, and exactly what was to be expected. The self-fertilized plants are,—at least in the reproductive features above mentioned,—unmodified and therefore just that much less provocative of sterility; whereas, the plants, incapable of self-fertilization, and which are crossed, are rudimentary in such features, and therefore just that much more susceptible of lessened fertility.

Here is the proof. He says (p. 66, "*Fertilization of Orchids*"):

"I have often noticed, that the spikes of the Bee Ophrys *apparently produced as many seed-capsules as flowers;* and, near Torquay, I carefully examined

many dozen plants, some time after the flowering season; and, on all, I found from one to four, and occasionally five, fine capsules; *that is, as many capsules, as there had been flowers (!); in extremely few cases* (excepting a few deformed flowers, generally on the summit of the spike), *could a flower be found which had not produced a capsule (!). Let it be observed, what a contrast this case presents, with that of the Fly Ophrys,* WHICH REQUIRES INSECT AGENCY, *and which* FROM FORTY-NINE FLOWERS, PRODUCED ONLY SEVEN CAPSULES!

"From what I have seen of other British Orchids, I was so much surprised at the self-fertilization of this species, that, during many years, I have looked at the state of the pollen-masses in hundreds of flowers, and I have never seen, in a single instance, reason to believe that pollen had been brought from one flower to another. Excepting in a few monstrous flowers, I have never seen an instance of the pollinia failing to reach their own stigma."

These results stare him in the face. Not only, as he admits, does it "seem conclusive, that we here have a plant which is self-fertilized for perpetuity;" but, these plants even exceed—and enormously exceed—the crossed plants, in fertility! The test of fertility, here flatly contradicts his "law."

After such a blow at his law, he concludes to abandon such a dangerous test. He falls back upon one of those mysterious, occult factors, which he evokes, whenever he is in a dilemma, and vaguely declares that "*some* great good" is derived from crossing, and *some* kind of evil from self-fertilization. He even says (p. 71), respecting the "*some* great good" (which the reader will remember has, with him, ever been in-

creased fertility), resulting from the crossing of the plants incapable of self-fertilization:

"But the good, in the case of the Fly and Spider Ophrys is gained at the expense (*sic!*) of much lessened fertility!"

And immediately thereupon, he says:

"In the Bee Ophrys, great fertility is gained, at the expense (*sic!*) of apparently perpetual self-fertilization."

Such self-stultification (so coolly, and complacently committed, too!) is unparalleled, in the annals of thought. Naught but itself could be its parallel. We have known of a humorous individual, who upon being confronted with a fact signally confounding the view he took, then coolly maintained the proposition contended for by his adversary. But, we never knew of such a device being resorted to, in all seriousness, as it has here been, by Darwin.

His argument, the reader will remember, has always been the direct converse of this. When he specified, what the evil of close-breeding was, his argument was, viz., Self-fertilization, or close-interbreeding, is at the expense of much lessened fertility! Here, however, he shows increase of fertility; and, as if he were bent upon starting the ghosts of Aristotle, Bacon, and Comte, horror-stricken, from their graves, he coolly deduces the proposition, that the *fertility is gained at the expense of self-fertilization!* His argument also was: Crossing, *per se*, is productive of the good of much increased fertility! Here, he shows crossing occasions loss of fertility! and, then, notwithstanding that he has shown evil, where his argument required

good, he says, "*The good * * is gained at the expense of much lessened fertility!*" The reader will appreciate the difficulty of dealing with a theorist, to whom all results are apparently welcome, as well those which seemingly favor his theory, as those which signally confute it.

Well, may he say, that the above case is, to him, "perplexing, in an unparalleled degree." Upon the theory of reversion, or proportionate development, the phenomena are perfectly explicable. Some of the plants have had their reproductive organs modified. Hence the incapacity for self-fertilization. Their crossing does not much improve their fertility, because all those, with which they cross, are similarly modified. Other plants are not modified; hence, physiologically, their great fertility; and hence, physically, their capacity for self-fertilization. Their great fertility is not due to their self-fertilization, but to the fact that they are not, or but little, modified.

With respect to the facilities afforded to insects, Darwin, if he lists, may invoke his doctrine of Final Causes, and contend, that such apparent adaptations were constructed, in anticipation of the sterility which would accrue from the modification of any parts of the plants, and in view of the necessity there would then exist for crossing the plants. The light of science has as yet scarce begun to dawn, in that wide department of nature, wherein lie the many beautiful correlations which subsist between different organisms, and between organisms and the physical world.

A chick, with its advent into the world, scarce

accomplished, yet beautifully concentering its muscles and sight, with a view to the capture of a passing insect, is a phenomenon which is to be seen, just within the portals of a world of knowledge, which needs as yet a Columbus to explore. But, unresolved as such coadaptations may be; and, however much they may subserve physiological purposes—as they unquestionably do, for many species which are ill-proportioned would long since have become extinct, were not crossing effected, with them, by means of insects—the truth remains, that no crude, empirical inferences from such unexplained data, will avail against the law, that physiological integrity is consistent, only with full development, in any individual, of all the characters of its species; and that neither self-fertilization, nor close-interbreeding, can in any way affect such integrity where the above condition, proportionate development, is fulfilled.

CHAPTER XII.

Sterility of Hybrids.

An objection, which has ever obtained, to Darwin's theory, is the fact of the sterility of species, when crossed, or the sterility of the hybrids from a cross between two species. This has ever precluded the idea of the evolution of one species into another.

Since varieties cross readily, and their offspring are fertile, this feature, of the sterility of hybrids, clearly appears to be a fundamental distinction between varieties and species.

Darwin admits the fact, of the sterility of species when crossed, or of their hybrids, and recognizes the antagonism it bears to his hypothesis.

He says (p. 293, *Origin of Species*):

"Hybrids * * have their reproductive organs functionally impotent, as may be clearly seen in the state of the male element in both plants and animals; though their formative organs themselves are perfect in structure, as far as the microscope reveals."

Again, on p. 299, *Origin of Species*, he says:

"I doubt whether any case of a perfectly fertile hybrid can be considered as thoroughly well authenticated."

On p. 27, *Origin of Species*, he says:

"It is difficult, perhaps impossible, to bring forward

one case of the hybrid offspring of two animals, clearly distinct, being themselves perfectly fertile."

On page 327, *Origin of Species*, he says:

"The perfect fertility of the many domestic varieties differing widely from each other in appearance, for instance those of the Pigeon or (those) of the cabbage, is a remarkable fact; more especially when we reflect, how many species there are which though resembling each other most closely, are utterly sterile, when crossed."

On page 126, Vol. ii, *Animals and Plants, &c.*, he says:

"The domestic races of both animals and plants, when crossed, are with extremely few exceptions, quite fertile. * * The offspring, also, raised from such crosses, are likewise generally more vigorous and fertile than their parents. On the other hand, species when crossed, and their hybrid offspring are almost invariably, in some degree sterile; and here there seems to exist a broad and insuperable distinction (*sic*) between races and species."

On page 213, Vol. ii, *Animals and Plants, &c.*, he says that, where species are crossed, "though size is often gained, fertility is lost."

On page 490 of same volume, he says:

"There is, however, one important constitutional difference (!) between domestic races and species. I refer to the sterility which almost invariably follows, in a greater or less degree, when species are crossed, and the perfect fertility of the most distinct domestic races, with the exception of very few plants, when similarly crossed. It certainly appears a remarkable fact, that many closely allied species, which in appearance differ extremely little, should yield, when united,

only a few more or less sterile offspring, or none at all; whilst domestic races, which differ conspicuously from each other, are when united, remarkably fertile, and yield perfectly fertile offspring."

He finds it impossible to reconcile this sterility, with his theory. But, he has endeavored to show, that the objection may not be so conclusive against his theory, as it appears to be. He essays this, in two ways, each of which betrays about as cool a device as may be conceived.

He argues, (1) that the objection should not be deemed conclusive, because there is an infinite number of degrees of fertility, and of sterility, among even individuals of the same species, all of which phenomena, he says, are inexplicable; and argues that, therefore, our ignorance of such phenomena, deprives us of a full assurance, that the obvious and conceded import of the sterility of hybrids, is the true one!

He argues further, (2) "that the invariable sterility of first crosses between species, and of their hybrids, is not a special endowment, but is incidental on modifications slowly impressed, by unknown means, on the reproductive systems of the parent forms."

1. It is on page 327 of his Origin of Species, that he advances the first argument (?). He there exclaims, "how ignorant we are on the precise causes of sterility;" and asserts, that, in presence of all the cases of lessened fertility, and of sterility, among individuals of the same species, "we must feel how ignorant we are, and how little likely it is, that we should understand, why certain forms are fertile and other forms are sterile when crossed."

It is in pursuance of this design, to show "how ignorant we are," and thus to weaken the force of the principal objection to his theory; that he, in his different works, devotes such an amount of space, to the many instances of crossing and of close-interbreeding, of which "we are so ignorant."

It is with this same design, that he says (p. 462, Vol. ii, *Animals and Plants, &c.*):

"With respect to the sterility of hybrids, produced from the union of two distinct species, it was shown in the xixth chapter, that this depends exclusively on the reproductive organs being specially affected; but, why these organs should be thus affected, we do not know any more (*sic*) than why unnatural conditions of life, though compatible with health, should cause sterility, or why continued close-interbreeding, or the illegitimate union of dimorphic or trimorphic plants should induce the same result."

The idea he wishes to convey, is, that the whole subject of sterility and of fertility, forms such an inextricable maze, that it is presumption, in any one, to say, that any aspect of the question, either rebuts, or confirms, any theory. In other words: instead of explaining anything to his readers, he demands of them to give up, for his gratification, the little positive knowledge they have upon the subject, merely because there is quite a number of similar orders of facts which seem inexplicable! It is a curious feature, discernible throughout all of Darwin's works purporting to prove the evolution of the species, that his hypothesis absolutely demands, that an embargo should be laid on the acquisition of any knowledge of the cause of any class

of facts he has in hand. His theory requires, that all of the phenomena of Variation, of Reversion, of Correlation, of Crossing, of Close-Interbreeding, of Generation, &c., be deemed inscrutable, ultimate in their character, and absolutely inexplicable. True it is, that his theory demands this, not without reason; for, as the reader sees, knowledge of the causes of these phenomena, explodes his theory.

The answer, to be made to his argument of an appeal to every person's ignorance of the causes of the evil effects of close-interbreeding, and of the good resulting from crossing individuals of the same species, is,—that there is no such ignorance!—all of the phenomena, to which he appeals, as being inexplicable, are susceptible, as has been fully shown in previous chapters of this book, of a full qualitative and quantitative explanation. Evil effects flow from the interbreeding of individuals of the same species, because such individuals have characters of their species, reduced or suppressed. Those differences in the quantity of effects, which make Darwin so confident, that the subject is hopelessly confused, are simply due to corresponding degrees of defective development, in the individuals so interbred. The good resulting from the crossing of varieties, is, as has been shown, due to the fact, that one variety contributes, to the offspring, a character or characters which the other variety lacks; and the physiological gain, evidenced in the fertility resulting, is because, by such contribution of characters, the mongrel offspring has removed the nearer to the perfect type of the species. Those dif-

ferences in the quantity of these good effects, which Darwin similarly accounts as phenomena the cause of which "no fellow can find out," are due to the different degrees, in which each such pair of varieties, contribute characters to such offspring. There is no phase of sterility, or of fertility, which is not susceptible of clear explanation, by means of the theory of reversion.

Therefore: his argument of an appeal to other things of which we are assumed to be ignorant, must fall to the ground, when it is found that we are *not* ignorant of those things. We shall show below, that this appeal of his, to the different degrees of fertility and of sterility, with individuals of the same species, instead of getting him out of one difficulty, only causes him to put his foot into another, infinitely worse. The explanation of those things of which he assumes we are ignorant, is replete with disproofs stronger, by far, than is even the fact of the sterility of hybrids.

2. It is on page 330, of his *Origin of Species*, that he advances his other argument, viz., That the sterility of species, and of their hybrid offspring, is not "a special endowment," but has been slowly acquired. He there repeats his argument from ignorance, and adds his second reason why the objection, founded on sterility of hybrids, should not obtain. He says:

"The general fertility of varieties, considering how entirely ignorant we are on the causes of both fertility and sterility, does not seem to me sufficient to overthrow the view taken" (by himself) "that the invariable sterility of first crosses between species, and of

their hybrids, is not a special endowment, but is incidental on modifications slowly impressed, by unknown means, on the reproductive systems of the parent forms."

There are three answers to be made to this view, that the sterility of hybrids "is not a special endowment, but is incidental on modifications, slowly impressed, by unknown means, on the reproductive systems of the parent forms."

(1.) It is a barren assumption. Not the faintest intimation, or conjecture, does he give of the manner in which this sterility might have been acquired. The phrase, "unknown means" (a twin brother of "innate tendency," of "nature and constitution of the being," of "a great law of nature," and of that legion of other metaphysical entities which serve him in good stead, whenever he is in a dilemma), proves conclusively, that he had as little idea of what he meant, when he propounded his "view," as his readers may derive from his proposition.

(2.) There is not a scintilla of evidence, in his works, which, upon the most liberal construction, can be tortured into proof, that the sterility of hybrids was ever acquired by modifications slowly impressed.

(3.) There are modifications, which have been impressed, and are still being impressed, by *known means*, however, on the reproductive systems of the varieties which he terms "incipient species," or "species in the process of formation;" but, these modifications, so far from accounting for the sterility of hybrids, consistently with his hypothesis, demonstrate most clearly,

that the sterility of hybrids was never slowly acquired, but that it is "a special endowment;" that varieties are not "incipient species," nor ever can become distinct species; and that each species is physiologically fixed.

Now, let us see, what the facts should be, to meet the requirements of his hypothesis (what, indeed, by the above argument of his, he intimates that they should be); and then observe what the facts really are, by his own showing. It will then be seen, that the sterility of hybrids is not the only physiological argument, in favor of the fixity of the species; but that the fertility and sterility of individuals of the same species, add arguments of even superior weight, in demonstration of the same fact, of the immutability of the species.

Here is what it was absolutely requisite, that Darwin should have shown, to obviate the objection of the sterility of species, and of their hybrids:—

Seeing, that hybrids,—the result of a cross between different species,—are invariably sterile, it is clear that if the conception, that the varieties of a species were "incipient species," or species in the process of formation, were a true one, we should expect, that the more marked, distinct, and widely divergent such varieties became, they would grow sterile, in proportion, when crossed with each other; as sterility is the characteristic of distinct species:

If the differences, between varieties, do really become augmented into the greater differences between species, all fertility, among the mongrels of such varie-

ties, should grow less and less; and those mongrels should acquire, by degrees, the sterility characteristic of hybrids:

Furthermore; as it is generally characteristic of individuals of the same species, to be fertile with each other, the fertility of the individuals of each variety, when bred, *inter se*, should grow greater, and greater, in proportion as the variety, to which they belonged, diverged:

Long continued domestication, or this divergence of character which according to Darwin evolves the varieties into species, should eliminate any tendency to sterility, with the individuals of the same variety; and eliminate any tendency to fertility, with the mongrels between such varieties:

The individuals of different varieties should grow mutually sterile, and the individuals of the same variety, should grow more fertile:

The greater the structural differences, between varieties, the more sterile should be their mongrels.

Such are *not* the facts. The facts are diametrically at variance with those required by Darwin's hypothesis.

On page 162, Vol. ii, *Animals and Plants, &c.*, he says:

"It deserves especial attention, that mongrel animals and plants which are so far from being sterile, that their fertility is often actually augmented, have, as previously shown, their size, hardihood and constitutional vigor generally increased."

Again, he says, p. 326, *Origin of Species*:

"Varieties, however much they differ from each

other in external appearance, cross with perfect facility, and yield perfectly fertile offspring."

On page 200, *Origin of Species*, he says:

"How can we account for species, when crossed, being sterile, and producing sterile offspring, whereas, when varieties are crossed, their fertility is unimpaired!"

Again he says, page 236, Vol. i, *Animals and Plants, &c.*:

"* * The more distinct the breeds, the more productive are their mongrel offspring."!

In divers other portions of his works, he has, as has already been shown, also declared, that the more divergent the breeds, the less fertile are the individuals of each variety, when bred *inter se*. He says, that individuals of divergent varieties are extremely liable to sterility, degeneration, and death, when bred *inter se;* and that crossing needs must be resorted to, all the time, with such individuals, in order to remedy such sterility, and prevent their extinction.

So, it is manifest, that the "modifications which are slowly impressed on the reproductive systems," tell a tale, not only in refutation of his "view," but also infinitely more significant of the falseness of his theory, than is even the sterility of hybrids. The facts prove, that the sterility of hybrids has not been acquired, as the varieties diverged. The facts, on the contrary, prove, *that varieties grow more and more unlike distinct species, the further they diverge.* The facts show, that the varieties not only do not acquire sterility, in their crosses, as they diverge in character; but *that, as they*

diverge, they actually grow more fertile when they cross, and that, by means of crossing, they eliminate whatever tendency to sterility has been produced by divergence, in their individuals!

So far from any difference, however great, inducing sterility in the varieties, or in their mongrels, that circumstance it is, which gives the crossed breeds, and their mongrels, the greatest increase of fertility! This shows, that the structural differences of varieties, are not being augmented into the greater differences which distinguish species. Not only is the assumption negatived completely, that varieties are "incipient species," and that the sterility of species, and of their hybrids, has been acquired, as the varieties grew, by divergence, into species; but the very converse obtains. There are modifications slowly impressed upon the reproductive systems of animals and plants, by the reduction or suppression of their characters, but those modifications add additional force to the objection founded on the sterility of hybrids. Independently of this fact of the sterility of hybrids, and even though the question of a limit to variation, had not been resolved, as it has been; the fact that the varieties, of a species, are incompetent to become distinct species, would have been shown, by the phenomena of the lessened fertility, and of the sterility of the individuals of such a modified species. The explanation of variations, by means of reversion, disproves Darwin's theory. The sterility of hybrids disproves Darwin's theory: And,—to perfect the demonstration,—the phenomena of the close-interbreeding and crossing of the indi-

viduals of the several varieties of a species, disprove Darwin's theory.

If the reader will reflect on the steps by which lessened fertility and sterility, among individuals of the same species, are acquired, he will appreciate the blunder which Darwin made, when he sought to obviate the objection of the sterility of hybrids, by asserting that such sterility might have been slowly acquired. *Darwin says, that divergence of character, in varieties, leads to the evolution of distinct species. He then shows, that the further such divergence of character is carried, the nearer do the individuals of each such divergent variety, approach complete sterility and death! and that the only way that this sterility and extinction may be staved off, is by the individuals of such variety, crossing with individuals of another of the varieties of that species,*—WHICH PROCESS UNDOES THE VERY DIVERGENCE OF CHARACTER, UPON WHICH DARWIN DEPENDS TO SHOW THE EVOLUTION OF THE VARIETIES INTO DISTINCT SPECIES!

As divergence of character is occasioned by the exclusive possession, by each variety, of some positive peculiarity which (being a peculiarity) needs must, therefore, be absent in all of the other varieties of the same species; and, conversely, is occasioned by the absence, in each variety, of all the positive peculiarities of the other varieties; evil effects result from close-interbreeding. As these evil effects become intensified, degree for degree, with the divergence of such varieties, it is clear, that distinct species cannot be evolved from such varieties, for those varieties are fast verging on death and

extinction. This death and extinction may be escaped, by doing what?—by crossing the varieties! which is, joining the characters of different varieties, in an individual, the mongrel. This mongrel is fertile and constitutionally vigorous, because it is not divergent,—because it has more of the characters of its species, than have the divergent individuals.

Very great structural differences may mark the varieties of a species. The characters of such species may be variedly modified, reduced, suppressed, retained in every stage of degeneration, or every stage of reversion, and apportioned among the different varieties, so as to make those varieties most widely divergent and more distinct in character, than are many species, or than are some genera. But, these diversities can subsist, within a species, only by impairing a physiological bond which normally ties together all the positive characters of the species. The further, therefore, any apportionment, or division, of the characters, among different varieties, is carried, the worse impaired becomes such bond; the weaker, and less fertile, grow the individuals of the divergent varieties; until, at last, that degree of impairment of the bond, is reached, which is incompatible with the function of the reproductive element, and with even the existence of the individual.

How, then, is it possible, for varieties to diverge into distinct species, when Darwin's own facts show demonstratively, that the only redemption possible, from death and sterility, is in returning to the full and proportionate development of all the characters of the

given species,—in acquiring, by reversion, or by crossing (or by grafting), the positive peculiarities of the other varieties. Is it not a farce, for him to adduce the pouter pigeon, the fantail, and the tumbler, as "incipient species," becoming distinct species by divergence of character, when the poor animals are almost completely sterile, and of a delicacy of constitution, due to the absence, in each individual, of the other organs and features possessed by the other varieties, and due to the peculiarity of the variety, having been carried to the extreme of development, without the concurrent development of the other characters?

The degrees of lessened fertility, and of sterility, among individuals of a species, trend in the wrong direction for Darwin's conception of the sterility of hybrids having been acquired. If the facts would but course, in exactly the opposite direction, Darwin's theory might have some semblance of probability, or vestige of support. If, for instance, the sterility had characterized the crossing of varieties, instead of the interbreeding of the individuals of each variety; and, if increase of fertility had marked the interbreeding, instead of the crossing, of individuals of the varieties, Darwin might have been justified in making light of the objection of the sterility of hybrids.

Professor Huxley (the gentleman who inculcates Darwinism, as an axiom, to the workingmen of England, and who teaches them resignation to their hard lot, by revealing to them, that their misery is but a beautiful exemplification of the grand, scientific principle of Natural Extinction, which is so necessary to

the Selection of the Plutocrats and land-holders), says, in an article in No. LII, of the *Popular Science Monthly:*

"What is needed for the completion of Darwin's theory of the origin of species, is, first, definite proof that selective breeding is competent to convert permanent races into physiologically distinct species."

As the reader has already been shown, the very antithesis to such proof is to be found in Darwin's facts. Darwin's facts show, that such definite proof, as Huxley requires, is absolutely impossible ever to be supplied. These demonstrate, that selective breeding (so far as it has any effect) endows permanent races with a physiological character, more and more unlike that of distinct species, inasmuch as it makes the individuals of each such race, sterile *inter se* (*i. e.* with other individuals of the same race), and gives them an increase of fertility and of constitutional vigor, when they are crossed with individuals of other races of the same species: a result, the direct converse of the character marking distinct species, whose individuals are, in the main, fertile with the individuals of their own species, and sterile with individuals of other species.

As has been mentioned, Huxley further says:

"What is needed for the completion of Darwin's theory, is, * * * secondly, the elucidation of the nature of variability."

Darwin's facts show, also, that there is an elucidation of the nature of variability; but such elucidation, equally with the solution of the physiological problem, militates against Darwin's theory, inasmuch as it shows, that there is a definite limit to such variability, and that

such limit precludes the possibility of the evolution of "permanent races," into distinct species. Huxley says, that Darwin starts with an incontestable assumption, viz., "the existence of living matter endowed with variability." Incontestable it is; but, Darwin essays, at the next stage in his argument, an assumption which is contestable, viz.: General ignorance of the law of such variability; and the absence, therefore, of any law forbidding his next gratuitous assumption, that variability is unlimited. This assumption is not tenable, for, (1) there is a law governing variability, and (2) such law completely imposes a limit to positive variations, while (3) the law of proportionate development imposes a limit to negative variations. All variability, of a positive character, is limited to the regain of characters, once lost by the species; and variability, of a negative character, is confined within a narrow range in each species, by the sterility and extinction which await the loss of a given number of the organs and features of such species.

The cause of the sterility, and of the lessened fertility, among individuals of a variety deficient in features of its species, is, that there are not sufficient characters in those individuals, to impress their reproductive tissue with due, formative power. The reason of the sterility of hybrids, is because the hybrid is formed of characters belonging to two different species, and, therefore, the result of the coördination of the characters of the organism is not directed to the required point. The influence of the aggregate is not centered upon that tissue which is specially prepared

for exudation from the organism, for reproductive purposes.

An individual, with all the characters of its species fully and proportionately developed, may be likened to a perfect, symmetrically-formed "burning lens," with all of the rays, which pass through it, determining to the center. An individual, belonging to a divergent variety deficient in some of the characters of its species, may be likened to the same lens, but notched, and with a ragged edge. The force, therein coursing, does but imperfectly converge; and the degree of the imperfection determines whether the effective concentration of the rays may at all be attained. If the imperfection be very great, the said effect will be wholly precluded. So, if the reduction of characters, in an individual, be great, the reproductive power is wholly absent, upon interbreeding with another individual similarly deficient. On the other hand, a hybrid,—the product of a cross between two distinct species,—may be likened to a glass, made in the similitude of a "burning lens" *with two foci*. The forces, contained therein,—which would be competent to the production of a given effect, were the rays converged to one point,—are, as there are two *foci*, rendered wholly inoperative for such a result. So; the hybrid would be fertile, were the point, or points, to which the influence of its aggregate determines, susceptible of being exuded. But, as there is but one point, viz., the site of the reproductive organs, where the structure contemplates exudation; and as the influence of the aggregate is not concentrated there, the hybrid needs

must be sterile. The above remark, that there is but one reproductive point in that individual, has reference solely to the animals highest in the scale of development. A plant has many such reproductive centers, and so have many animals low in the scale of development. But, *mutatis mutandis*, the principle also obtains with them. Strictly stated, it should be said, that in a hybrid, the influence of the aggregate determines to a point or points *other than those devoted to purposes of exudation.*

The reason, why closely-allied species produce at times hybrid offspring, is because they possess organs and features somewhat alike; and their reproductive forces, having come, severally, from pure species, need only to be sufficiently isochronous, to coalesce and concur in the mutual formation of an organism. The question, with the reproductive elements, in this case, is not one of formative power; for each, having been derived from a pure species which concentrated the influence of its aggregate upon the tissue which was physically adapted for exudation, they have, other things equal, the power of integration. The question is one, simply of the possibility of their uniting and working to the same end. The reason, why very distinct species are absolutely sterile with each other, —not capable even of the formation of a hybrid,—is not because of the reproductive elements of the two lacking the usual formative power, but because there is a physical impossibility of the two forces uniting, through each of them pursuing an absolutely different rhythm.

The hybrid, produced by the union of the two closely allied species,—though capable of coördinating within itself, the coalesced forces of the characters of the two species,—is incapable of reflecting the result of that coördination, to that point, or those points, where the process of exudation of tissue, is possible. If the forces of the whole organism are converged, as in a hybrid, to any point, and the tissue, there, be modified into a miniature likeness of the whole, such tissue is incompetent, by reason of the nature of the mechanism, to become exuded, *i. e.*, to sever the correlation in which it stands with the rest of the structure; and therefore cannot serve as a reproductive element. The hybrid, then partakes of the character of a crystal. It has all of its parts correlated; each of such parts, if exuded or detached, and if the environment were propitious, would be capable of reintegrating the whole; but the crystal has not the power of detaching a portion of itself, for the purpose of such reintegration. Each portion of a crystal is capable of reintegrating the whole. But, the crystal is not capable of exuding, or of detaching, a part of itself, for such a purpose. For a crystal to accomplish such reintegration, a part must be detached by force applied *ab extra*. Were it capable, by itself, of this detachment, it would be, in all essentials, like an organism. Another characteristic of an organism (possessed by a crystal, but in small degree if at all), is that susceptibility to the influence of its environment, which entails that ebb and flux of the coördinating force, which is displayed in the waste and repair of its tissue. This

recurrence of alternate degeneration and reintegration, is a general characteristic of life; but it is absurd to pronounce it Life itself. It is more in keeping with the phenomena, to term the coördination of actions, Life. This Herbert Spencer has done; but he has made an egregious mistake, when he fancies, that the coördination, peculiar to any species, is susceptible of any normal modification.

As before remarked, there is no necessity more imperatively felt, than that of a test by reference to which, the precise nature and bounds of the several species, may be susceptible of ascertainment; and, as the absence of all explanation, both qualitative and quantitative, of the varied phenomena of sterility and of fertility, has heretofore lain in the way of attaining such a test, the importance of the solution herein given of such varied phenomena, cannot well be over-estimated. The hybrid is the sole possible element of confusion, in the practical classification of species. Such organism, whilst in theory affording no difficulty, may be often, to the naturalist, a temporary source of confusion. But, its sterility will preclude the possibility of its confusing specific distinctions. Although; when an individual, of one species, with some of its characters reduced or suppressed, crosses with an individual of another species, which has characters so like those which the former lacks, that they may serve to repair, in a measure, the defect in the coördination of the former; gain in constitutional vigor results to the hybrid offspring of such a cross; the hybrid will, however, be sterile, and the line of descent from either parent-form,

will (so far as this hybrid is concerned) forever end. There is a definite and absolute failure of issue, with the hybrid; unlike the failure of issue, in the case of an individual of a pure species, whose sterility is caused solely by its reproductive element being modified by the forces of an inadequate number of the characters of its species. As Darwin has noted, from observations made, the sterility of this individual is not absolute: As Darwin, however, has failed to note, the reason its sterility may be remedied, is because it needs only to mate with another individual of the same species, which has the complement of characters required for the purposes of reproduction, or which (failing to possess such complement) can contribute other characters which the former lacks, the addition whereof to the number it already possesses, may make up the number which is necessary to restore fertility.

CHAPTER XIII.

Concluding Remarks.

To recapitulate, the controversy stands thus:

1. Darwin says, that variations or improvements arise among animals and plants, under domestication.

This has been conceded.

2. Darwin's next proposition, is, Descent with Modification: That is, that when a modification is acquired by an individual, the law of Inheritance generally transmits the acquired character to the offspring.

This, also, has been conceded.

3. Another proposition of Darwin, is, That many organs, or characters, after having been in a state of full development, have been so wrought upon by the adverse conditions of Nature, as to become, viz., some of them, slightly reduced; others of them, greatly reduced, having the character of rudiments merely; and others of them, completely suppressed, leaving not a vestige of their past development.

This proposition, also, has been fully conceded.

4. A proposition, which Darwin formulates respecting these reduced and suppressed organs and characters is, viz., That, given, favorable conditions these reduced and these suppressed characters are competent to reappear, and on many occasions have reap-

peared, even after having lain latent for millions of generations.

This, too, has been conceded.

5. Darwin's next point, is, viz., That it is competent and allowable to take the amount of variation or improvement, positively known to take place during (say) the last hundred years, or during the historical period, and therefrom to estimate the amount of variation or improvement possible to occur within a million of years, or other long interval of time. This proposition has been demurred to, because such a proposition necessarily involves

6. The further proposition, viz., That variations, or improvements may proceed without any limit to them, or multiply to an indefinite extent.

This assumption, of his, of No Limit, has been shown to be, both intrinsically erroneous, and conclusively negatived by Darwin's most important factor.

It is intrinsically erroneous, because it is both gratuitous and illegitimate.

First: It is gratuitous, because no evidence whatever is adduced by Darwin, showing that the variations, or improvements, are without a limit, or that they may proceed to an indefinite extent. In fact, the most curious feature in Darwin's theory, and in every theory of Evolution which has been propounded, is that this assumption of No Limit remains a tacit assumption throughout all of his works, and throughout all works on the subject; notwithstanding that it is an indispensable point in such theories, without which they could not be constructed.

Second: This assumption of No Limit, is illegitimate, because the sole, possible warrant which might have been urged to sustain it,—viz., the presumption that, as variations are now seen to go on multiplying, they may still go on multiplying forever, or indefinitely, or may have, in the past, gone on multiplying indefinitely,—is invalidated by reason of Darwin's precedent (alleged) failure to resolve the law or the cause of variations, which law or cause, if discovered, would, presumably, have determined whether there was or was not a limit.

Third: This assumption of No Limit is, on the other hand, negatived by the fact, that the law of Variations is actually resolved by Darwin, and that law,—namely, Reversion, or the principle of the regain or re-development of characters which were previously lost or reduced,—imposes a definite limit to the Variations;—no more characters may be regained than were originally lost by the respective, varying species.

7. Darwin's next proposition is, that it is possible, upon principles of analogy, that Variations now arise, under Nature, and that they may, in the past, have there arisen, in much the same manner that Variations arise under domestication; and that those Variations may have frequently given their owners such an advantage, in their competition with their fellows, as to secure to them a prolonged existence, and the opportunity of leaving offspring in whom the said variations would be continued.

No exception has been taken to this proposition,

save this, viz., that he has not resolved the law or cause of such possible variations, and thereby ascertained whether the variations are amenable or not to any limit; and that he has illegitimately referred them to an "innate tendency" which he has the grace to confess, is but a name for his ignorance.

8. Darwin's next proposition is, that there is, and has ever been, a fearful Struggle for Existence waging almost incessantly under Nature, among the different animals and plants.

No exception has been taken to this proposition.

9. His next proposition is, that the effect of this Struggle for Existence, is the Natural Selection of "the strongest and most vigorous" individuals, and the extinction of the weakest and least fitted to live; and he implies that, by this Selection of "the strongest and most vigorous," slight increments of development are secured, in each generation.

Exception has been taken to this proposition, because there is a fallacy resident in the terms "strongest and most vigorous." Viewed with reference to the hard conditions of the Struggle for Existence which he pictures, to which even these elect are subjected, the terms to be used, should have been, the least weak and the least degenerate. When these terms are used, no implication of any advance in development arises, as it does, when the terms, "strongest and most vigorous," are used. The implication of advance in development, from the Selection of the best of any one generation, may arise only where exist, both, Selection, and favorable conditions. Under domestication,

these two requisites generally concur. Under nature, they do not,—even according to Darwin's showing. Selection is present, there; but, by the very terms of Darwin's argument, the other requisite—viz., favorable conditions,—must be absent, in order to effect the Natural Selection. According to the very terms of his argument, if this requisite of advance in development—favorable conditions—were present, the other requisite—Natural Selection—would necessarily be wanting; for unfavorable conditions are required (according to Darwin) to work off the weakest and most degenerate, and thus occasion the Selection of the others.

Subject to this qualification, the principle of Natural Selection has been recognized. *The argument from Natural Selection, however, is a different matter.*

10. Darwin's next proposition, is that those slight variations which are assumed to arise occasionally, under nature, "in the course of thousands of generations;" and those slight increments of development which are assumed to be the outcome of the Natural Selection of "the strongest and most vigorous" of each generation, may be accumulated by Natural Selection to an indefinite or unlimited extent: in other words, that by means of the accumulation of such occasional variations and of those slight increments of development, the higher animals have all been evolved from the lowest forms of life.

Exception has been taken to this proposition for the same reasons which were urged against the assumption of unlimited variation, when it was considered

independently of the question of Natural Selection. Such a conclusion, of indefinite or of unlimited results from Natural Selection, involves the assumption that the accretions of development, represented by the strongest and most vigorous individuals and the variations present in the varying individuals, proceed forever, or without any limit: Whereas, as has been before shown, such assumption of No Limit is both (1) gratuitous, and (2) illegitimate, and (3) is negatived by the fact that the sole law of which such variations and such increments of development are susceptible, viz., Reversion, imposes a limit to such variations and increments, and consequently restricts the extent of the accumulation of such, which is effected by Natural Selection.

Thus the controversy stood, before the positive disproofs of Darwin's theory were developed. Such theory was shown to be untenable because of three salient objections. These were (to repeat):

First: This assumption of No Limit (which assumption is absolutely essential to his theory) is invalidated by being gratuitous; *i. e.*, for want of any evidence to sustain it:

Second: His assumption of No Limit is invalidated by being illegitimate; *i. e.*, by reason of his precedent (alleged) failure to resolve the law, or the cause, of variations, which, if resolved, would presumably have informed him whether these variations were, or were not amenable to a limit.

Third: His assumption of No Limit is invalidated by reason of the fact that a certain law—viz., Rever-

sion—which constitutes his most prominent factor, really explains those variations, and imposes a definite limit to them.

If the theory that variations are due to Reversion;* that the improvements arising under domestication are due to the reappearance of characters lost or reduced under nature; and that the variations or increments of development which are preserved and accumulated by Natural Selection, under nature, are but the regain of what was lost by the respective species, at some former period; be true, then Darwinism, and every theory of Biology, of Psychology, and of Sociology, which is based upon the assumption of the unlimited accumulation of those slight increments of development, known as Variations, must be false.

But is the theory of Reversion true?

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* Of course, the positive features which are due to Reversion, and which are essential to the integrity of a species, do not comprise pathological characters where (for instance) inorganic, or foreign, or misplaced, organic processes of integration have effected a coalescence with the normal forces of growth. Nor do they include the features of local hypertrophy, or other monstrous growths.

The perfect type, of any species, is not the sum of all the modifications of which all the characters of such species, are susceptible, but it is the sum of all the positive characters of a species, as those characters are when fully and normally developed. These words, "fully and normally," do not here beg the question as they would were the theory dependent upon its mere agreement with the facts; for, we have the crucial test of self-fertilization, or of close-interbreeding, by which to determine what is normal and what abnormal. That which is abnormal will ever manifest itself in the evil attendant upon self-fertilization or close-interbreeding.

There is one of the features of species, which may occasion doubt. Reference is had to color. It is difficult, frequently, to tell what color,

It has to recommend it, that it is in full accordance with all the facts of Variation.

It has to recommend it, that the weight of probabilities is in its favor.

It has to recommend it, that there is no converse assumption competent to explain the facts of Variation.

It has to recommend it, that the law of Reversion to which it looks for an explanation, is a well-known scientific factor.

It has to recommend it, that there is no fact which is inconsistent with such explanation.

It has to recommend it, that, in default of such explanation, there is no recourse but to a metaphysical entity, an "innate tendency."

But, great as are the intrinsic defects of Darwin's theory, and overpowering as are the above considera-

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or variegation of colors is proper and normal to any given species. The difficulty lies in this: When any other feature is abnormal in any way, evil is entailed by self-fertilization, or by close-interbreeding, either immediately or when such process has been long continued. In such way, the abnormal character is ascertained: But, with an abnormal color, the evil entailed thereby, is so inappreciably small, that the test of interbreeding, or of self-fertilization, is practically valueless.

As has been before remarked, the Converse Theory, propounded in this work, has relation, directly, solely to the problem of Variations. Darwin's problem was, How species were evolved. But, in the solution of such problem, he employed these Variations as his *data*, and contended that the species were evolved simply by the indefinite accumulation of such Variations. To confute him, a converse theory of the Evolution of the Species, was not needed, but a converse theory, merely, of his data, namely the Variations. Such theory has here been supplied, showing that the evolution of species was not accomplished by means of Variations; that each species is normally im-

tions in favor of the theory of Reversion, we have not relied, for the Refutation of Darwinism, upon these points alone. We have not left the theory of Reversion dependent upon its mere agreement with the facts, or sustained by a mere balance of probabilities; nor have we counted, for its acceptance, upon the mere fact that the law to which we look for an explanation of the phenomena, and which alone is competent to explain those phenomena, is a well-established scientific factor, whose additional recommendation is that it is assimilable to other well-known laws, such as that of the reproduction of lost limbs, that of the redintegration of tissue, that of the repair of injuries, and all laws whose operation is to restore the lost integrity of an organism.

Such considerations are amply competent to the

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mutable; and that each was evolved from a distinct, independent center of inorganic forces. If such converse theory, or History of Variations, be true, it is competent, also, to the refutation of the whole of Herbert Spencer's synthesis, of Bain's hypotheses, and of every theory of Biology, of Psychology, or of Sociology, which assumes that those slight increments of development, known as Variations, may be accumulated indefinitely.

But, although the converse theory of the Evolution of Species, is not needed to the explosion of Darwinism, or other theory of general evolution,—the question of whether or not these are true, being definitively settled by the phenomena of Variation,—a detail of the modes of integration in which the several species were evolved from independent centers, is desirable on other grounds. Therefore, in a future work on The Special Evolution of Species, founded principally, if not exclusively, upon data furnished by Darwin, Bain and Spencer, the evolution of species from independent centers; the differentiation of organisms into sexual, neuter, and otherwise modified individuals; the cause which determines the sex of off-

refutation of Darwinism, but they do not suffice to entitle the theory of Reversion to a place within the body of positive truths.

We have, however, supplemented such arguments and evidences, with adequate, scientific proofs of the truth of the theory of Reversion, and with positive disproofs of the theory of Darwin. The phenomena of Crossing and of Close-Interbreeding accomplish these ends, with the full, unerring force of demonstration.

These phenomena declare the law, beyond all controversy or cavil, to be, viz., that the positive variations in each species are but the regain of what was previously lost by such species; that that organic structure which is the sum of all the possible developments of its species, is alone consistent with full physiological integrity; that there is a limit to Variation in both directions, in the direction of increase and in the direc-

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spring; which occasions the transmission to an individual of either sex of the primary and secondary, sexual characters of the opposite sex; the philosophy of hydrophobia, of catamenia, of petrifaction, of the several phases of metamorphosis, and of monstrosities; and the phenomena of embryology, will receive an explanation as complete as that which has been given of the phenomena of Crossing and Close-Interbreeding. This synthesis—the principles of which shall be evolved from the facts, and descend again to the facts, by as rigorous processes of induction and deduction, as have characterized the present work—will include the true theory of classification; the explanation of numerous, recondite, psychological problems; an explanation of the history and function of the cæcum; and such a full and detailed explanation of the function of the cerebellum, as harmonizes the two seemingly conflicting classes of facts which now are appealed to by the advocates, respectively, of the two prevailing theories.

tion of decrease; that there is a limit in the direction of increase of structure, or to positive Variations, for no more Variations can occur in any species, than that amount of characters or features which such species once lost; that there is a limit in the direction of decrease of structure, or to Degeneration, or negative variations, because any organism which falls short of the full organic complement of its species, has thereby entailed upon it, a proportional physiological, evil effect, while if such modification of the specific type be carried beyond what is a comparatively very narrow margin, the effect upon the fertility and constitutional vigor of the individual will be such as to entail the extinction of its line, and death to itself; that the structural degeneration which has taken place under nature, in almost every species, has been in derogation of the physiological integrity of the individuals, and this is evidenced by the evil effects which accompany the close-interbreeding of individuals of each such species; that each and every return which is made towards the full structural complement, viz., the original perfect type,—made, either, by means of direct Reversion, or positive Variation, by means of Crossing (whereby the offspring has, contributed to it by either parent, a character or characters which the other parent lacked), or by means of Grafting,—is fraught with proportional increase of physiological good, or fraught, rather, with proportional abatement of the evil which was caused by the departure from such normal build.

The obvious import of this law, of proportionate development, is that each species is normally immutable.

The state of the individuals, previous to their development of positive variations, is a deficient, physiological condition, due to their deficient, structural condition. Their positive variation is a structural return, which is attended by a return to a perfect physiological condition. The same result is effected by Crossing. By this process, two individuals which have made structural returns, in different ways or in different characters, toward the original mould of their common species, combine those characters, or the bases thereof, in their offspring; and the augmented return, so induced, meets with a proportional response in the gain in fertility and vigor which is ever then observed.

If the variation, under domestication, be of a negative character, the departure from the normal type is then evidenced by the lessened vigor and lessened fertility which mark this departure from physiological integrity, which follows fast upon any departure from structural integrity.

As, then, the reduction, or suppression of any character, is ever observed to entail physiological evil, the deficient physiological condition of any organisms, in a state of nature, or when just placed under domestication, must imply the reduction and suppression of some characters in those individuals; and, it follows that any development, subsequently under domestication, of positive variations, must be the recovery, merely, of such lost characters—especially, as it is observed, that the regain of such lost characters, or the appearance of such variations, is attended by a like and proportional decrease of the physiological, evil

effects under which those individuals were observed to suffer.

The following propositions illustrate the manner in which the normal immutability of each species, has been demonstrated by this law, of the complementary nature of the structural integrity, and of the physiological integrity of organisms.

From Darwin's repertory of facts this induction has been made, viz.:

11. That there has been degeneration in each species under nature, to the extent of a margin commensurate with the margin of the possible, positive variation in that species, under Domestication.

Warrant for this induction, is to be found

First: In the conditions of the Struggle for Existence, which needs must have been very adverse, if Darwin's graphic description of them is to be received:

Second: Warrant for the induction, of Degeneration under Nature, is to be found in the many rudimentary organs which, Darwin says, were once in a fully developed state; and the scope of this degeneration may be conceived when Darwin says that these rudiments "imply an enormous amount of modification," and when he says, that "there is scarcely a single species under nature which is free from such blemishes."

Third: Degeneration is shown by the many organs which, Darwin declares, have been greatly reduced and simplified by the action of the conditions of Natural Selection:

Fourth: This degeneration is shown by the many

characters which, Darwin shows, have been so wholly suppressed that not a vestige of their past development now remains.

Fifth: This degeneration is shown by the many "latent" characters and organs, "proper to both the right and left sides of the body, and to a long line of male and female ancestors," which lie, according to Darwin, within every organism, and which need only the proper conditions, to reappear.

Sixth: This degeneration is shown by the numberless characters which Darwin ascribes to Reversion—Reversion necessarily implying, as Darwin admits, past reduction or suppression of the characters which now revert.

12. The next induction is, That all of the positive Variations, or improvements, in each species, are due to the mere regain of the characters which were lost or reduced in such species, under nature; and that they are limited, therefore, in number and kind to the number and kind of the characters so lost or reduced, under nature.

Warrant for this is found

First: In the previous proposition, and in the proofs adduced in support thereof.

Second: In the numberless instances where Variations are ascribed, by Darwin, to Reversion, the exceptions being rare where he does not thus account for the phenomena of variation.

Third: In Darwin's admission that all Variations are susceptible of such explanation, his only objection being that they must at some time have arisen as new

Variations, and thus formed the species: Such objection, however, is obviously absurd; as that point—viz., that species were formed by the mere accumulation of Variations—is the very conclusion which he is striving now to attain, by means of these very Variations which he admits are most probably the mere regain of what was previously lost. If the mere regain of what was lost, they manifestly stop when all that was lost is regained; and therefore, having a limit, they cannot have formed the several species.

Fourth: Warrant for the assumption that all positive Variations are but the mere regain of what was lost, is found in the fact that Reversion is a well-known, well-established, scientific factor.

Fifth: Warrant is found in the fact that Reversion is, confessedly, the sole explanation of which positive variations are susceptible.

Sixth: Warrant is found in the fact that there are no phenomena which militate against such explanation.

Seventh: Warrant is found in the fact that the sole alternative of the explanation of Reversion, is an "innate tendency," or other metaphysical entities which Darwin admits are but synonyms of ignorance.

Now to the *proofs* of the foregoing propositions.

A proposition of Darwin, is, That self-fertilization, or in-and-in breeding is injurious, and productive of sterility, of lessened fertility, loss of constitutional vigor and loss of size.

An analysis of the facts upon which he professes to found this proposition, discloses:

13. That self-fertilization, or in-and-in breeding is not, *per se*, injurious;

14. That it is the loss or reduction, in the individuals, of some of the characters, proper to their species, which causes the evil results which are so frequently seen to follow self-fertilization and in-and-in breeding:

15. That, when the individuals are fully and proportionately developed in all the positive characters of their species—that is, when the perfect type, which is normally immutable, is realized in the individuals—they may be self-fertilized, or closely interbred in the nearest degree of relationship, without any evil results.

Proof of these propositions is found

First: In the fact that animals and plants in the state of nature, and when first placed under domestication, are susceptible of the evils resulting from close-interbreeding, to a degree corresponding with the amount of reduction or suppression of characters, which either is known to have occurred, or which is implied by the individuals' subsequent development of positive features:

Second: In the fact that these evil results from close-interbreeding abate (other things equal) in proportion as the variations appear under domestication; or in other words, in proportion as the reduced or suppressed characters which occasioned the evil, redevelop.

Third: In the fact that, where other things are not equal, viz.,—where Man's selection has been so erratic as to preclude the proportionate re-development, in each

individual, of all the lost or reduced characters—the evil results from close-interbreeding correspond most faithfully, degree for degree, with the disproportionate development of the individuals—the variations in the quantity of the effects observed, tallying exactly with the variations in the quantity of cause assigned.

The modes of Man's Selection which thus vary the evil results, may be conveniently classed as four: viz.,

a. That mode of Selection which, while it re-developes all or most of the lost or reduced characters of a given species, does not develop them all in the same individuals, or in the same variety; but, instead thereof, apportions or distributes them among different varieties, thereby causing each variety of said species to lack the many important characters which constitute the peculiarities of the other varieties of the same species, and thereby restricting such variety to one only of the recovered characters, which is pushed to an extreme of development which aids the more to mar the true proportion.

This process of Selection is exemplified in the case of the Pigeon, and of the Fowl.

In consequence, therefore, of each variety of either of these species, lacking the characters, which have been appropriated as peculiarities by the other varieties of the given species, and in consequence of the extreme, disproportionate development of the special excellence of each variety, it was to be expected, that the interbreeding of individuals of each such variety, would be prolific of great evil results. This expectation has been fully justified by the facts, from Darwin,

recorded in the chapter on Pigeons and Fowls. These animals not only display the greatest evil upon close-interbreeding, but,—in conclusive refutation of Darwin's theory that the Pigeon and Fowl best illustrate the divergence of character which (he fancies) evolves varieties into species,—the further the varieties diverge, the more sterile and weakened in constitution do they become! proving clearly that divergence of character cannot result in the evolution of distinct species, for the apportionment or separation of characters, which it involves, is in derogation of the fertility and strength of the individuals so diverging, and comes soon to a dead stop within a very short interval, owing to the sterility and excessive delicacy of constitution which the absence in each individual, of the characters which form the peculiarities of the other varieties of the same species, entails.

b. Another of the modes of Man's Selection, which vary the evil results, is that mode which, instead of—or in addition to—re-developing lost or reduced characters, continues the reduction or suppression of characters of the species; thereby greatly modifying the normal type which is the sum of the full and proportionate development of all the positive characters of the given species.

This process of Man's Selection is exemplified in the case of the Pig which—in what are esteemed the best, domesticated breeds—has its snout reduced, the front of its head short and concave, its bristles well-nigh suppressed, its legs reduced to a size often incompatible not alone with locomotion, but with the very

support of the animal, and its tusks almost obliterated.

In consequence of this degeneration, the interbreeding of individuals of the domesticated breeds is pregnant (as has been shown) with very great loss of fertility and of constitutional vigor; greater, in fact (as Darwin shows, unconscious as he is of the reason), than in the case of any other large animal; greater, in fact, than with any other animals, save, perhaps the Pigeon in which the true principles of development, have been equally outraged, only in a somewhat different way. On the other hand, in the interbreeding of the least well-bred animals of this species (the Pig), the evil results, owing to the nearer approximation to the normal type of the species, are in a measure absent.

c. Another of the modes of Man's Selection which vary the evil results of Close-Interbreeding, is that mode which, in a great measure, re-develops all or nearly all of the lost or reduced characters of the given species; leaving the varieties to be distinguished from one another, simply by some slight variations in the ratio of the development of the species' characters.

This process of Man's Selection is exemplified, in a greater or less degree, in Horses, Sheep, and Cows.

In consequence of this mode of Selection, so favorable to development, the interbreeding of individuals of each variety of either of these species, is observed to be replete with very little evil results; the well-proportioned animals often being capable of very close and long continued in-and-in breeding, without the slightest apparent prejudice; and, where evil is ob-

served to result, it is ever traceable to the individuals which are paired, being similarly wanting in full structural integrity.

d. Another of the modes of Man's Selection, which vary the evil results of Interbreeding, is that mode which re-develops only one of the lost or reduced characters of the species; the several varieties of each such species being formed by the mere retention of each variety at a different stage of the exclusive development of this one character.

This process of Selection is principally exemplified in the case of Plants, there being, in each species, generally only one character which Man values, and to which exclusively he devotes his attention. In one species, it is, perhaps, the fruit alone which he prizes; in another, it is the flower; in another, the leaves; in another, the roots, &c. The extreme development of this one, valued feature, and the reduction, both positive and relative, of the other characters of the species, have sensibly modified the normal structure of the Plants.

In consequence of this modification of the structural integrity of Plants, there is observed to be an injurious modification of the physiological integrity, which reveals itself when the Plants are self-fertilized, or when two individuals, similarly modified, are interbred; loss of fertility, loss of constitutional vigor, and sterility being the outcome of such self-fertilization, or of such interbreeding, in proportion to the degree in which the parents similarly depart from the full, structural integrity of their species.

All of the species under domestication furnish con-

firmation to the doctrine that each and every modification of the type of the sum of all the positive characters of a species, is fraught with physiological injury which beyond a very narrow limit entails the extinction of the line of the individuals so modified.

So, even if all the individuals of every species in the world had departed from the types of their respective species, and even if there were no form extant, which realized the perfect type of its species, the type of each species would not be involved in doubt; for it is ever susceptible of ascertainment. Interbreed the individuals, and the evil effects, consequent upon such process, will furnish a perfect register of the amount of departure which they have made from the original, normal form. By careful breeding, modify a human being, until he closely resembles a monkey—in the length and proportion of his arms and legs, in the contour of his head, in his facial angle, in the character of the ribs, &c.,—place the man and a monkey side by side; and if structural differences alone are to be taken into account, as Darwin holds, there would be a close similarity between the two. But, when physiological tests are applied, there is revealed a wide distinction. Breed either of the two, with one of its own kind, similarly modified, and it will respond, and give a faithful register of the distance it has removed from its normal type. The human being will be prolific of the greatest possible evils; thus evidencing the enormous amount of modification which it has suffered. The monkey, on the other hand, will be free from all display of evil effects; or, possi-

bly, will evince a slight degree of evil, after long-continued and very close interbreeding; thereby evidencing that it has departed not at all, or but slightly, from the perfect type of its species.

16. As, then, the loss or reduction of characters, in any individual, is observed to entail physiological injury; and as, previous to their variation under domestication, organisms are observed to be defective in proportion to the number of characters which it is subsequently observed to be possible for them to develop under domestication, it follows that those positive variations which appear under domestication, are but the regain of characters which the given species lost under nature.

17. Further proof is furnished by the fact that the physiological defects, which are occasioned by the loss or reduction of characters, are ever observed to abate in proportion as the individuals develop the variations which appear under domestication; thus proving that such variations are but the regain of the characters whose loss or reduction caused the physiological injury.

18. Warrant for this is found in Darwin's remark that "Domestication, as a general rule increases the prolificness of animals and plants."

19. If, however, further proof be required, it is found in abundance in the phenomena of Crossing, which as it is the converse of the law of Close-Interbreeding, is fraught with more significance than if it were evidence of an independent character. Besides, by means of the several modes of Man's Selection, which have been

before detailed, the good resulting from Crossing is infinitely varied; and the close correspondence which is seen to subsist between such variations in the quantity of the effects, and the like variations which are pointed out as prevailing also in the quantity of the cause assigned, proves the theory of Reversion to demonstration.

20. Darwin says that it is "a great law of nature that good should follow Crossing."

An analysis of the facts upon which he professes to found this law, discloses

21. That Crossing is not, *per se*, beneficial; but is the mere occasion of the good which results;

22. That the cause of the good resulting from Crossing, is to be found in the fact that, in that process, each of the crossed parents contributes, to the formation of the offspring, a character or characters which the other parent lacks; the physiological good which is observed to follow, being consequent upon that induced, structural remove toward the perfect type, which is thus effected by the union in the offspring, of the positive peculiarities of both parents.

Proof of these propositions is found

First: In the fact that the good resulting from Crossing is ever observed to be in proportion to the amount of the positive, structural differences of the crossed parents;

Second: In the fact that where either parent has no positive features to contribute to the offspring, which the other parent lacks, there is, relatively to such last mentioned parent, no increase of good whatever displayed by the offspring.

Third: In the fact that where a variety has all of the positive features of its species; or, where it possesses all of the positive features which characterize the other varieties of the species, no advantage accrues from its crossing with another variety.

To these proofs and evidences, has been added the following, which sets an effectual bar to the admixture of distinct species, and shows that there exists "a broad and insuperable distinction between varieties or races and species:"

23. Species when crossed, are either sterile themselves, or produce offspring which are sterile.

The obvious and even the admitted import of this phenomenon is diametrically opposed to Darwin's theory. Darwin, however, has attempted two hypotheses, with which to obviate the force of this objection to his theory. These wholly fanciful hypotheses of his are not only susceptible of signal confutation, but the one, viz., that even individuals of the same species are susceptible of all degrees of lessened fertility and sterility, and that therefore sterility is not distinctive of species; and the other, viz., that this sterility subsisting between different species, may not be a special endowment, but may have been induced by modifications slowly impressed by unknown means, on the reproductive systems of the parent forms; recoil with ten-fold force upon him and his theory, and disclose the full extent of the significance with which the sterility of hybrids is fraught.

The phenomena, of lessened fertility among individuals of the same species, to which he appeals, show

incontestably that not merely are those phenomena inconsistent with his suppositions, but that the very converse and refutation of them prevails. They show that the sterility of hybrids, *is* "a special endowment," and that, instead of the sterility of hybrids having been induced by slowly acquired modifications, it is the lessened fertility of individuals of the same species, which has been induced by modifications, and that not only do such modifications operate in a way the very reverse of that required by his gratuitous supposition; but, in proportion to his Divergence of Character (which he fain would believe evolves varieties in distinct species), do those varieties become of lessened fertility and of lessened vigor, culminating very soon in death and extinction.

Thus, from four several quarters of the science of Biology—namely, first, from the phenomena of Reversion which fix a limit to positive Variations; second, from the phenomena of Interbreeding which, in the opposite direction, fix a limit to negative Variations, by entailing evil effects upon any organism in proportion to the modification of the perfect type of the given species, which such individual has suffered, which evil effects amount to complete sterility and extinction, at a point which is comparatively a very small remove from such perfect type; thirdly, from the phenomena of Crossing, which show that only in proportion as an individual regains the features which it lacks, and recovers the lost integrity of its species (whether the same be effected by direct Variation, by Crossing, or by Grafting), does it regain its lost physi-

ological integrity, its fertility, and constitutional vigor; and fourthly, from the phenomena of the Sterility of Species, or of their Hybrids which proves that there is an insuperable bar to the admixture of the species—do the facts converge to the following conclusions, viz.:

That there is but one, normal mould or type for any given species:

That such normal type alone is consistent with physiological integrity.

That the several, existing varieties, or races, of any given species, are but negative modifications, or segments of the proper type of such species:

That any departure from the full, structural integrity of the perfect type of the given species, is fraught with proportional physiological evils:

That any return towards the perfect type of the given species, is attended with proportional abatement of the physiological evils under which the individual suffered: and

That each species, although susceptible of countless injurious modifications, is normally immutable.

THE END.

THE END OF DARWINISM

Not Change but Persistence is Characteristic of Life
Every Change is Essentially a Persistence;
Only what Persists can Change.

AN ESSAY

—BY—

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THE END OF DARWINISM

I have before me an article in which I read:—"With different modifications the theory of evolution is now accepted by every competent mind in the civilized world. What does that mean? It means that since the far off beginning—I say beginning, because I do not know how else to express my thoughts, for we can conceive of no beginning—there has been gradual growth, from the simple to the complex, from the lower to the higher, from the poorer to the relatively better."

The theory of evolution is not accepted by every competent mind, and it is not accepted for compelling reasons. The truth is, that not one *fact* has been discovered which substantiates the theory, and many facts which prove it to be erroneous, not only erroneous but impossible. It is a conception of nature, which is not at all the last thought of science but on the contrary the simplest and crudest of explanations. It is as plausible and as apparently self evident a truth, as the truth that the earth is a stationary plate in the centre of the universe around which the river Oceanus flows and the sun and stars revolve. Buechner praises the Indian for his lack of prejudice in calling the wolf his brother. No savage doubts the evolution of one species into another. Every Hottentot believes in spontaneous generation. The Babylonians and Egyptians of old held the same notions concerning life. Some of the Greek philosophers preached this doctrine. Aristotle held it. Anaximander forbids the eating of fish for the reason that 'fish is father and mother of man.' Kant

said, 'the assumption of a spontaneous generation followed by an evolution into more perfect forms lies so close and is apparently so self evident a truth that there are probably but few naturalists, even among the most clearsighted and ingenious, who have not at some time cherished an hypothesis of that sort'. It is not held, that the highly organized living beings owe their existence to spontaneous generation. In 1675 Anton van Leeuwenhoek discovered the bacteria, and immediately the question arose do these generate spontaneously, or are they the descendants of beings of the same kind? In 1749 Needham held that the bacteria developed spontaneously. Spallanzani 1769 drew attention to the laxity of Needham's methods. Schulze, Dusch, Schwann, Schroeder, Hoffmann, Pasteur, Tyndall proved by the convincing nature of their experiments that the presence of living organisms is due always to the preexistence of similar living forms. Cohn of Breslau demonstrated that some bacteria have the ability of passing into the spore stage, in the course of their life, in which stage they are more able to resist deleterious influences. This discovery was the death blow to the doctrine of spontaneous generation; and we now know that nothing is more certain than the truth of Harvey's law "Omne vivum ex vivo". The bacteria have no chlorophyll, and are therefore unable to obtain nitrogen and carbon from such simple bodies as Carbon dioxide and ammonia, they must get their carbon and their nitrogen as such from organic matter. The bacteria are as active in their life cycle as the so called higher organisms. They cause profound changes in the organic matter on which they live. Developing in the living body, the parasitic bacteria cause disease and death. The saprophytic bacteria cause decomposition, putrefaction, and fermentation, and thus they resolve the tissues of dead organisms into the simpler compounds carbonic acid, water and ammonia, in which form they serve as nutrition for the more highly organized members of the vegetable world, without which simpler compounds these plants cannot live. They

cannot get their carbon and nitrogen from the complicated substances which are the foodstuff for bacteria, the bacteria furnish the green plants with the simple compounds which these can use, the plants that possess chlorophyll having the power in the presence of sunlight to break up these compounds into their constituents. Were it not for the activity of the bacteria, which furnishes food to the plants, there could be no plant life, and as all animal life is dependent directly or indirectly on the vegetable world, there could be no life at all upon earth. The socalled "low" and the socalled "high" forms of life are interdependent, they necessitate and presuppose one another; without the "higher" forms of life, no "lower" forms are possible and without the "lower" forms there can be no "higher" forms. Every living being depends on every other living being.

The Darwinists suppose, they claim it as a dogma, that in primeval times, infinitesimal particles of primeval dust coalesced into an infinitesimal primeval Darwin-Haeckel; it was the beginning of life, no other life existed. This living thing, which Darwinists say was simple, must at the same time have been able to perform what it takes bacteria, chlorophyll plant and animal life in conjunction to perform. The assumption is an absurdity. How could this living thing live in isolation? And the more simple this living thing is supposed to have been the more absurd is the supposition that it could live in isolation; if on the other hand this living thing was the wonder that could perform what it takes all living beings in conjunction to do, then it was not simple, but the most complex, the most compound, the most highly organized being that ever existed in fact or in imagination. In either case the Darwinistic theory is proved an untenable assumption. We know that not only every living being is the product of another living being, but that every living being is the product of a living being of the same kind and type, a chromogenic bacteria is the product of a chromogenic bacteria, a photogenic bacteria of a photogenic bacteria, a nitri-

fying bacteria of a nitrifying bacteria, a diphtheria producing bacteria of a diphtheria producing bacteria and not of a tuberculosis producing bacteria and so forth. Were this not the case we could have no science of bacteriology. This means that persistence is the essence of life and not change as the Darwinists hold.

The simple cell is an essential part of the Darwinistic Credo. It is its cornerstone. Twenty-five years ago it was ignorance to speak of the simple cell, today it is conscious fraud. The more perfect our microscopic lenses become, the more clearly do we recognize that "simple cell" is a contradiction in terms. We now know that the infusoria have many interdependent parts, each organized to perform its function. They have a circulatory system and organs of digestion, assimilation and reproduction. Hermann Nikolaus Maier has shown that they have organs of special sense. Other scientists point to the amoeba as the simple cell. Professor M. Foster in his "Textbook of Physiology" says "The amoeba is a simple being; it renews its substance, replenishes its store of energy and sets free energy now in one form, now in another, and yet the amoeba may be said to have no tissues and no organs * * *. Using the more familiar amoeba as a type and leaving on one side the nucleus" (Why? Is the nucleus not an organ belonging to the amoeba?) "we may say that its body is homogeneous. * * *. Now the great characteristic of the typical amoeba, leaving out the nucleus" (With what right? Have I the right to say that the great characteristic of man, leaving out the internal organs, is that he is bone covered by muscle?) "is that as far as we can ascertain all the physiological units are alike, they all do the same things. Each and every part of the body receives food more or less raw and builds it up into its own living substance; each and every part of the body may be at one time quiescent and at another time in motion, each and every part is sensitive and responds by movement or otherwise to various changes in its surroundings. * * * The

body of the amoeba is frequently spoken of as consisting of protoplasm". This protoplasm is evidently a wonder, not at all simple, but from Prof. Foster's description most complex. Professor Foster continues: "The body of man in its first stages, while it is yet an ovum if we leave aside the nucleus and neglect differences caused by the unequal distribution of food material or yolk, may also be said to be composed of like parts or like physiological units". This is a remarkable sentence, it is absurd. If the parts were homogeneous, how could the different parts develope so differently? Because we do not see the differences in the first stages, does that justify Prof. Foster in saying that there are none? He continues "By the act of segmentation however the ovum is divided into parts or cells which early show differences from each other and these differences rapidly increase as development proceeds. Some cells put on certain characters and others other characters". Mark this "The cells put on character" and "the differences rapidly increase". According to this scientist the physiological units were at first homogeneous, the putting on of this or that character on the part of the cells and the rapid increase of the differences between them, therefore means the growth of something out of nothing. Prof. Foster states further "Each physiological unit of the amoeba while it is engaged in setting free energy so as to move itself, and by reason of its sensitiveness so directing that energy as to produce a movement suitable to the conditions of its surroundings, has at the same time to bear the labor of taking in raw food, of selecting that part of the raw food which is useful and rejecting that which is useless, and of working up the accepted part through a variety of stages into its own living substance, that is to say has at the same time that it is feeling and moving to carry on the work of digesting and assimilating. It has moreover at the same time to throw out the waste matter arising from the changes taking place in its substance having first brought these waste matters into a condition suitable for being thrown

out". Mark, that this is said not of the amoeba as a whole, but of each and every particle of the amoeba. And is it simple? No, it is the most complex tissue imaginable, the wonder of wonders. We now know that this wonder of wonders does not exist. The amoeba has a contractile vacuole which means a circulatory apparatus, the processes in multiplying are very complex and indicate internal organs. "The amoeba", says Prof. Foster, "may be said to have no tissues and no organs, at all events this is true of closely allied but not so well known simple beings". Prof. Foster probably refers to the myxamoeba which are said to be so "low" that it is difficult to classify them. De Bary, Cienkowski and others studied them under the microscope on culture media. Instead of being simple they found the myxamoeba and its life cycle very complex. The myxamoeba is at first aquatic and moves about by means of a flagellum, this it loses as the tadpole its tail and it becomes terrestrial. Now many individual myxamoebas coalesce and form colonies, these colonies undergo profound changes. Variously marked and variously colored spore capsules are formed containing spores; capillary vessels (capillitium) with complicated arrangements for the protection and spreading of the spores are noticed. Under certain conditions the colonies break up again into their individual components. The sporangias, the spores and the complicated frame of the capillitii permit a classification into groups, genera and species. (v. Houston Stewart Chamberlain "Immanuel Kant"). This "simple" living being is not at all simple. It is as complex as man himself.

Nowhere has a trace of the Darwinistic "simple" living being or of the "simple" cell been found. Every day we recognize more clearly that many differentiated elements constitute the cell, and nowhere has a sign of the evolution of one being into another been found. Like produces like; that is true not only of the cell as a whole, but also of the individual components, parts, organs which constitute the cell. No nucleus without a

previous nucleus, no nucleolus without a previous nucleolus, no centrosome without a previous centrosome, no chromation without previous chromation, and so forth. The "simplest" cell consists of parts which are interdependent and presuppose and necessitate each other. Life is organization.

Does the science of palaeontology (the science of the ancient life of the earth or of its fossil remains) substantiate the theory of evolution? In the lowest strata of the fossiliferous rocks that contain the earliest forms of life are found the evidences, that the fauna then was just as rich and just as highly organized as the fauna that exists on the bottom of the ocean today. Prof. Brooks of John Hopkins University, a Darwinist, finds that the forms there found, very far from being the simple unspecialized ancestors of the present fauna are zoologically speaking intensely modern and belong to the same order of nature as the fauna of today. Neither present nor early times justify us in accepting the Darwinian dogma.

The study of man does not substantiate Darwinism. It flatters us to believe that in comparison with us our grandfathers were dull and stupid, we alone are great, greater than any generation that preceded us; progress, progress, this century, this generation produced more greatness than all the others combined. History does not substantiate this belief. There is no essential progress, which justifies the acceptance of the theory of the evolution of man. Not one new sense has been added to the senses of man. He has no more today than in the grey dawn of history. Has his mind evolved from a lower to a higher sphere, so that we overtower the ancients in ability, intelligence, morals? History says "No". In literature the Greeks produced Homer and Sophokles. The last two thousand years produced two men only as incommensurable as these—Shakespeare in England and Goethe in Germany. How does our epic poetry compare with the old Teutonic sagas, The Volsungen sagas—in essence if not in workmanship as great as the Homeric poems?

And have the Hindoos not produced Kalidasa, the poets of the Vedas, of the Mahabharata, of the Ramayana? Where is evolution in literature? Where is our architecture that merits comparison with Gothic or Hellenic architecture? We have some fine buildings, such as the capitol in Washington, but these are imitation from cellar to roof. We are proud of the republican form of government, as if this were something new and essentially American. History teaches that all forms of government known to man existed at all times. Absolute democracies, absolute monarchies, constitutional republics, constitutional monarchies, socialistic communities and communistic societies. The wise king knew that there was nothing new under the sun. The form of government is in itself of no importance. That form is best which assures the greatest amount of self government, and this is as often found in a constitutional monarchy as in a republic. Eternal vigilance is the price of liberty no matter what the form of government is. Where vigilance abates a despotic oligarchy rules. No one will affirm that we have a higher conception of freedom than our Teutonic ancestors had or that we love freedom better.

Our morals are not better essentially than those of our ancestors, in some respects worse. Never before was there a time in which brewers drowned the world in beer as they do now. No narcotic was ever as widely used as the narcotic "alcohol" today is used. We are content with a double morality, our ancestors demanded chastity in men as well as in women. Where is there an evolution?

We are proud of our mechanical inventions and with justice. The prehistoric man, however, who first controlled fire instead of being controlled by it, who rendered fire useful to man, the men who discovered navigation, were men of as great genius as the greatest inventor of historic times. The man who made the first stone axe was as great a benefactor as the man who made the first steam engine. The alphabet, the art of writing, were

given us by prehistoric men. Think how little science we could have without the socalled Arabic notation of numbers. The man who invented the symbol " 0 " was a very deep thinker. The zero is no number, but a philosophical-metaphysical conception. It signifies the absence of all things, it is the point where the positive and the negative intersect. It has become so much a part of ourselves that we can no longer think without it. Figure out what 6 per cent. of " M " dollars are and you cannot do it, because consciously or unconsciously our mind translates the " M " into 1000. We owe this symbol to a great Hindoo thinker, who is unknown to history. Where is that evolution of the mind, where that progress that we are so proud of? We have more things, we know more than our ancestors, because we profited by their experience, because we are the descendants and the heirs of men as great and as good as we are and not the children of semi-apes. Was the prehistoric man in physique a semi-monkey? Some of the oldest prehistoric skulls are more roomy than the skull of the average white man of today. The more roomy skull had a bigger brain, and undoubtedly a greater intelligence. Johannes Ranke and Broca find that some of the races of the stone age were of the highest and noblest human development.

Evolution, however, must be and so the Darwinists close their eyes tightly in order not to see the facts. None are as blind as those who will not see. On the other hand Darwinists see things which do not exist, the " simple " cell is one of them; the original monkey is another. At first Darwinists held that man was the son of the ape. This was quickly seen to be impossible for anatomical reasons, and they promptly invented the original monkey of whom man and ape were the descendants. Gegenbauer writes ' no relation can be established between reptiles and mammals'. That troubles him little. ' We must', he says, ' assume that there was an original reptile that had the characteristics of both, mammals and reptiles'. These wild phantastic speculations are called biological science. On similar delusions

Prof. Haeckel bases his " biogenetic fundamental law ", which alleges that the individual in his development repeats the history of the race. Haeckel was not the first scholiast who preached this dogma. Bonnet declared it in 1768. Diderot in " Pensees sur l'interpretation de la Nature", 1754 delivered the whole theory of evolution. (v. Chamberlain, Immanuel Kant.) Ernst von Baer discovered the facts which the speculating Haeckel remolded in order to get his so called " law ". From Louis Agassiz, Haeckel took the palaeontological facts and thoughts. Both men protested against Haeckel's abuse of their work, pointed out the monstrosity of his hypothesis and showed that Haeckel thoroughly and radically, though perhaps unconsciously (being hypnotized by his own nightmare), forged the facts everywhere in order to make them agree with his theory. Agassiz in his " Essay on Classification " pointed out Haeckel's suppression of some facts and his falsification of others in establishing his genealogical trees. Milne Edwards in " Introduction a la Zoologic generale " laid bare the frivolity with which Haeckel twisted the truth. The whole of Haeckel's structure rests on contortions of truth. Houston Stewart Chamberlain and the Kepler League demanded him to rectify his falsification of facts, and to explain the changing and miscorrecting of embryonic plates, which made them suit his theory. The sixth edition of his " Anthropogenie " neither explains nor corrects these malcorrections. It is evident that Haeckel does not seek truth but notoriety.

It has been shown that spontaneous generation exists nowhere, that everything organized is the product of something organized. The Darwinists assume (it is nothing but a wild assumption) that in primeval times dead matter gave birth to life. All forces of nature are antagonistic to life as Edward Drinker Cope pointed out; the assumption that matter and energy produced life is a nonsensical conception. Mr. Cope says " It is more probable that death is a consequence of life, rather than that the living is the product of the non-living". It is a tale sim-

ilar to that of Baron Muenchhausen, who riding over a fen sank with his horse and when he was submerged to his belt thought of his queue, took hold of it and pulled himself and his horse out of the mire; so dead matter took hold of its Darwinistic pigtail and lifted itself into life. Prof. Gegenbaur writes "Let us imagine a simple organism". How can we know what that is? Prof. Gegenbaur tells us how this "simple" organism (the product of a diseased imagination) developed, and how by degrees it became perfectly organized and its parts adjusted. How this first organism that was no organism could live a second if it was not perfectly organized we are not told. David Hume asks "I would fain know how an animal could subsist unless its parts were so adjusted". We are told that an organizing principle arose (How? From what? Another instance of the growth of something out of nothing.) and developed the living thing into an organism. Prof. Ludwig Plate writes "The essence of selection consists in the separation of bodies fit for existence from those that are not fit for existence, and thus progress and perfection are produced". Dr. Savage writes "There has been a gradual growth from the simple to the complex, from the lower to the higher, from the poorer to the better." Literally a continuous creation of more out of less, of something out of nothing. No wonder that Kant calls the theory of evolution, which is the scientific credo of today "the common, superficial conception". Prof. Gegenbaur further states that 'due to an inherent variability' (another wild assumption) 'the organism changed and adapted itself." The inherent variability makes change possible, it is not the cause of the change or adaptation of the organism. What is the cause? Prof. Gegenbaur says "The cause of the adaptation is the advantage which accrues to the organism from the change". The advantage as a consequence of the adaptation gives sense, but as the cause of the adaptation it is nonsense (v. Chamberlain "Immanuel Kant"). The scientific scholiasts

of the nineteenth century do not at all favorably compare with the theological scholiasts of the Middle Ages.

In order to escape the doctrine of spontaneous generation Haeckel endowed matter with some degree of life, going back to the hylozoism of the ancients. This means that matter is not inert. The conception that matter is inert is the basis and foundation of all physical science. Let the notion that matter is not inert creep in even by the smallest loophole and we can have no science. Thus Haeckel-Herostratus deprives us not only of our science but of the very possibility of science. If man is nothing but developed matter, specialized into man by the blind working natural selection, it follows that man is not a free moral agent, and that is the Darwinian-Haeckelian conclusion. In other words man is an automaton; what meaning can God, duty, morals, love, sympathy, charity have for an automaton? None whatsoever. Thus the Herostrati deprive us not only of our science but of the best we have, of our personality.

In the science and art of medicine the evolutionary hypothesis has been and still is practically applied; it has led to the theory of rudimentary organs. These are organs, the Darwinists say, which in the supposed animal existence were of use to our ancestors, but are now discarded; they testify to some previous stage in our development. Prof. Wiedersheim in his Darwinistic intoxication has found 107 rudimentary organs in man. Mr. Houston Stewart Chamberlain says it is about time to write a book on the Human Body as Nature's Junkshop for Defunct Organs, and wonders whether the human brain is not the one hundred and eighth rudimentary organ. In medicine the Darwinian disease led to deplorable consequences. As these organs were declared to be useless, they were cut out for trivial reasons. The thyroid gland is a rudimentary organ, "Cut it out," and it was cut out. Many of the victims died from the effects of the operation, all the others developed myxedema (a form of cretinism). This rudimentary (!) organ was found to have an import-

ant function. The Darwinian construction of "rudimentary organs" is utterly untenable. There are no rudimentary organs, the functions of the organs so called are gradually being discovered. The two rudimentary (!) organs which are still being abused are the tonsils and the appendix. The tonsils have probably a protective function, the active phagocytosis going on in them destroying parasites, and because of this function at the most exposed part of the alimentary tract, they frequently become inflamed; they do not become inflamed because they are rudimentary (?) organs which the surgeon wants to excise. Many scalpel wielders (I do not say every surgeon), still consider themselves justified in exsecting every appendix that comes across their way. We do not yet know the purpose of the appendix, but it is very certain that it is not placed in the human body for the purpose of giving surgeons the opportunity to show their skill. In medicine the Darwinian mode of thinking has done and is still doing harm. The Darwinian theory muddled the brain of anatomists, physiologists and surgeons; it confused the unsuspecting public. The great sale of Haeckel's works speaks well neither for Haeckel nor for the public. The theory of evolution is a consequence, a symptom, and a cause of the materialism which is rampant; a materialism as crude and as superficial as that which infested imperial Rome.

Mr. Reader, lay aside for a moment the Darwinistic blinders and open your eyes. Do you see a change in living beings? Yes, of course,—but—you see a change only in beings *which persist.* You and I change between today and tomorrow, yet we persist. If we did not, we would not know ourselves. It is the nature of life to be elastic and its elasticity enables it to resist the antagonistic forces of nature. The essential thing is the persistence not the change. The phenomenon of regeneration proves the truly wonderful pertinacity of this persistence. "Only what persists can change." (H. St. Chamberlain). Every change is a persistence. Darwinism makes change the essence of life. It

is a revival of the doctrine of Heraclitus "Everything is in a flux, nothing persists, no one can step into the same river twice." Plato's answer to Heraclitus answers the Darwinian hypothesis. "If as Heraclitus maintains all things are in a flux and nothing persists, no knowledge is possible, for knowledge must necessarily connect a persisting object with a persisting subject. If everything is in a flux there can be neither a knowing subject nor a knowable object, and it is impossible to hold that there can be a knowledge of anything". As Darwin attempts to prove that everything is in the process of evolving into something else, Chamberlain thinks that the title of his famous book ought to read "The Origin of Species, which do not exist".

The Darwinian theory makes the world nothing but a retort, differing from the ordinary chemical retort in size only. Alfred Wallace says—"There is in all this (life) something quite beyond and apart from chemical changes." Otto Weininger holds that 'chemistry can get at the excrements of life only, not at life'. Hans Driesch writes: "The common chemico-physical interpretation of life is a phrase, it is more easy to make phrases than it is to think". To deduct life from matter and energy is, according to Prof. Tait, simply unscientific.

The time is ripe for a sane interpretation of nature; and it will read something like this. Matter is inertia, energy is mutability, life is neither matter nor energy nor a combination of these, but a third principle. Life is organization, which implies elastic persistence. Just as science substantiates conservation of matter and conservation of energy, so science substantiates conservation of life. The total quantity of life does not change. A change in one group conditions and corresponds to a change in another group. The creation of something out of nothing is in the domain of life as preposterous a thought as in the domains of matter and energy. Every living being depends on, presupposes and necessitates every other living being. An isolated living being is a Darwinistic nightmare, a preposterous thought.

Types persist there is no evolution of one into the other; in the case of man this means that racial types persist no matter what the environment is; the negro remains a negro in America as well as in Africa, the Jew a Jew under every sky, the Teuton a Teuton, and so forth. The changes these undergo under different enviroments are due to the elasticity of life, and are for the purpose of enabling the type to persist. Every change is essentially a persistence. The crossing of types that are not closely related (promiscuous crossing) leads to mongrelization, which is followed by deterioration and death. (The Greeks of Hellas, the Romans, the Aryan Hindoos) v. Chamberlain "Die Grundlagen des Neunzehnten Jahrhunderts", A. P. Schultz "Race or Mongrel".

The origin of life we cannot explain. We have to agree with Svante Arrhenius that the question how did life originate is similar to the question how did matter or energy originate. We will have to accustom ourselves to the thought that Life has no origin in time. The Darwinists attempt to demonstrate how life became organized. It is as senseless an attempt as if they attempted to demonstrate how matter gradually became inert or energy mutable. The very thought is preposterous. Goethe said "Lebhafte Frage nach der Ursache ist von grosser Schaedlichkeit". (Anxious questioning as to the cause is pernicious), and Roger Bacon said "Causas non oportet investigare". (v. H. St. Chamberlain "Immanuel Kant"). We have to be content with "God created".

Prof. Joseph Jastrow in an article entitled "Malicious Animal Magnetism" (Hampton's Mag. Oct. 1910) writes "Science builds slowly but safely. It is very very careful about the foundations. When men tried to build too fast and trusted more to imagination than to brick and mortar they produced pseudoscience, false and hollow which soon tottered and had to be pulled down. When they neglected the foundation they built up superstitions in commonplace affairs, and what may be called

pseudo-philosophy in more ambitious ones. The system of ideas back of Christian Science is a very crude form of philosophy". Put the word "Darwinism" in place of the words "Christian Science" and these sentences remain true. It is high time that this "English Disease" as Friedrich Dreyer calls it be shaken off. In the hullabaloo that Darwin-Haeckel and his followers set up, the voices of the great naturalists Immanuel Kant, Karl Ernst von Baer, Milne Edwards, Louis Agassiz, Richard Owen, Houston St. Chamberlain and others are not heard. The Haeckelian papism in philosophy is a danger to our culture. A sane interpretation of nature leads not to monism but to dualism. Every monism is a fraud, and pernicious in its effects. We must be free moral agents or have no moral laws, we must conceive nature a mechanism or have no science. The mechanical conception of nature is the necessary method for obtaining science. We have moral laws and we have science. Man is both free and bound. The Darwinistic interpretation of nature pretends to explain everything and to give the cause of everything; it is arrogant, presumptuous and suffers from theophobia. A sane conception of nature is modest, it knows that the sum total of all we know is to the sum total of all we do not know as a drop is to the ocean. Darwinists either tear their eyes open and say they see everything, there are no wonders, or they shut their eyes tightly and say they see nothing, there are no mysteries. How mistaken they are. Is the growth of a blade of grass, is the growth of a powerful tree from a little seed, is the starry sky not a wonder and a mystery. In fact everything is wonderful and mysterious. We study to *comprehend* things, *explain* them we cannot. The depth of the human mind, the infinity and mystery of the starry heavens impelled Kant to kneel down and worship. A sane interpretation of nature will not be without Kant's modesty. It will not be materialism. Present day materialism declares reason, thinking, life the product of not reasoning, not living matter. It makes mind a function, a secretion of the body.

The contrary is true; it is not the eyes that see or the ears that hear, it is I who sees and hears by means of my eyes and ears. Not my brain thinks, I think by means of my brain. The whole body is the organ of the soul. Man is an intelligence served by it. It is the I, the soul, that builds the body. Materialism declares man to be nothing but a combination of chemicals in the big retort called the world; and life the accident or fact of their combination. In truth man is not only a chemical-physical substance but also a metaphysical, a spaceless, timeless and therefore eternal being. His life not a mere fact or an accident, but a problem and a duty. "The essence of life," says Kant, "is of immaterial nature". In a purely material world ruled by necessity, there can be no morals. Materialism is therefore the chief enemy of humanity and of all culture. Time is money preaches materialism; it is in fact our chance to make ourselves, and to do good. The struggle for existence being a means and not an end does not prove untrue the words "God saw everything that he had made and behold it was very good". "Man," the Darwinists say, "is an animal, more highly endowed than the beasts of the field but differing from them in degree only". Man is an animal endowed with reason; but the true man, the moral, metaphysical, transcendental man is no animal at all. He is a spirit, an eternal being, the image of God. "Life," says Kant, "is the commercio of the soul and of the body. Birth is the beginning, not of the life of the soul, but the beginning of this commercio. Death is the end, not of the life of the soul, but the end of this commercio. Birth, life and death are but conditions of the soul. The substance persists, though the body vanishes."

Men of such convictions feel God in them, they know that they have nothing to fear but doing wrong, they are of good cheer knowing that nothing can happen to them but what God permits, they hold a hand that guides them, they fear no evil though they walk through the valley of the shadow of death. A little less materialism, a little less greed for material things and pleasures and everybody is better and happier.

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"Kritiken der Vernunft und Urteilskraft."
"Einzelne Betrachtungen und Ephorismen uber Naturwissenschaft im Allgemeinen."
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The COLLAPSE Of The THEORY Of EVOLUTION

IN 20 QUESTIONS



الله
رسول
محمد

HARUN YAHYA

The theory of evolution has been around for some 150 years, and has deeply influenced people's views of the world. The theory maintains that life came about by chance, by itself, and through natural conditions.

However, evolution is not supported by any scientific evidence. It is a dogma that materialist scientists and philosophers are trying to impose on society under a scientific mask.

The main foundations of this dogma, which has been disproved by modern science in many fields, are propaganda techniques consisting of cheating, forgery, contradiction, and sleight of hand.

This book is a guide for the layman. It considers the scientific invalidity of the theory of evolution in 20 commonly asked questions. The answers to these questions are based on the most recent scientific discoveries, and clearly reveal that the theory of evolution is nothing but a superstition.



ABOUT THE AUTHOR

The author, who writes under the pen-name Harun Yahya, was born in Ankara in 1956. He studied arts at Istanbul's Mimar Sinan University and philosophy at Istanbul University. Since the 1980s, the author has published many books on political, faith-related and scientific issues. His main focus has been the refutation of Darwinism and materialism, two modern myths presented under a scientific guise. Some of the books of the author have been translated into more than 30 languages and published in the countries concerned. Harun Yahya's books appeal to all people, Muslims and non-Muslims alike, regardless of their age, race, and nationality, as they center around one goal: to open the readers' mind by encouraging them to think about some critical issues such as the existence of God and His unity, and to display the decrepit foundations and perverted works of godless systems.

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HARUN YAHYA

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TO THE READER

In all the books by the author, faith-related issues are explained in the light of Qur'anic verses, and people are invited to learn God's words and to live by them. All the subjects that concern God's verses are explained in such a way as to leave no room for doubt or question marks in the reader's mind. The sincere, plain and fluent style employed ensures that everyone of every age and from every social group can easily understand the books. This effective and lucid narrative makes it possible to read them in a single sitting. Even those who rigorously reject spirituality are influenced by the facts recounted in these books and cannot refute the truthfulness of their contents.

This book and all the other works by Harun Yahya can be read individually or discussed in a group. Those readers who are willing to profit from the books will find discussion very useful in that they will be able to relate their own reflections and experiences to one another.

In addition, it is a great service to the religion to contribute to the presentation and circulation of these books, which are written solely for the good pleasure of God. All the books of the author are extremely convincing, so, for those who want to communicate the religion to other people, one of the most effective methods is to encourage them to read these books.

It is hoped that the reader will take time to look through the review of other books on the final pages of the book, and appreciate the rich source of material on faith-related issues, which are very useful and a pleasure to read.

In them, one will not find, as in some other books, the personal views of the author, explanations based on dubious sources, styles unobservant of the respect and reverence due to sacred subjects, or hopeless, doubt-creating, and pessimistic accounts that create deviations in the heart.

THE COLLAPSE OF THE THEORY OF EVOLUTION IN 20 QUESTIONS

HARUN YAHYA

February, 2003

About The Author

The author, who writes under the pen-name HARUN YAHYA, was born in Ankara in 1956. Having completed his primary and secondary education in Ankara, he then studied arts at Istanbul's Mimar Sinan University and philosophy at Istanbul University. Since the 1980s, the author has published many books on political, faith-related and scientific issues. Harun Yahya is well-known as an author who has written very important works disclosing the imposture of evolutionists, the invalidity of their claims and the dark liaisons between Darwinism and bloody ideologies such as fascism and communism.

His pen-name is made up of the names "Harun" (Aaron) and "Yahya" (John), in memory of the two esteemed prophets who fought against lack of faith. The Prophet's seal on the cover of the books is symbolic and is linked to the their contents. It represents the Qur'an (the final scripture) and the Prophet Muhammad, the last of the prophets. Under the guidance of the Qur'an and sunnah, the author makes it his purpose to disprove each one of the fundamental tenets of godless ideologies and to have the "last word", so as to completely silence the objections raised against religion. The seal of the final Prophet, who attained ultimate wisdom and moral perfection, is used as a sign of his intention of saying this last word.

All author' s works center around one goal: to convey the Qur' an' s message to people, encourage them to think about basic faith-related issues (such as the existence of God, His unity and the Hereafter), and to expose the feeble foundations and perverted ideologies of godless systems.

Harun Yahya enjoys a wide readership in many countries, from India to America, England to Indonesia, Poland to Bosnia, and Spain to Brazil. Some of his books are available in English, French, German, Spanish, Italian, Portuguese, Urdu, Arabic, Albanian, Russian, Serbo-Croat (Bosnian), Polish, Malay, Uygur Turkish, and Indonesian, and they are enjoyed by readers worldwide.

Greatly appreciated all around the world, these works have been instrumental in many people recovering their faith in God and in many others gaining a deeper insight into their faith. The wisdom, and the sincere and easy-to-understand style gives these books a distinct touch which directly effects any one who reads or studies them. Immune to objections, these works are characterized by their features of rapid effectiveness, definite results and irrefutability. It is unlikely that those who read these books and give serious thought to them can any longer sincerely advocate the materialistic philosophy, atheism or any other perverted ideology or philosophy. Even if they continue to do so, it will be only a sentimental insistence since these books refuted such ideologies from their very foundations. All contemporary movements of denial are now ideologically defeated, thanks to the collection of books written by Harun Yahya.

There is no doubt that these features result from the wisdom and lucidity of the Qur'an. The author modestly intends to serve as a means in humanity's search for God's right path. No material gain is sought in the publication of these works.

Considering these facts, those who encourage people to read these books, which open the "eyes" of the heart and guide them to become more devoted servants of God, render an invaluable service.

Meanwhile, it would just be a waste of time and energy to propagate other books which create confusion in peoples' minds, lead man into ideological chaos, and which, clearly have no strong and precise effects in removing the doubts in peoples' hearts, as also verified from previous experience. It is apparent that it is impossible for books devised to emphasize the author's literary power rather than the noble goal of saving people from loss of faith, to have such a great effect. Those who doubt this can readily see that the sole aim of Harun Yahya's books is to overcome disbelief and to disseminate the moral values of the Qur'an. The success and impact of this service are manifest in readers' conviction.

One point should be kept in mind: The main reason for the continuing cruelty, conflict, and all the ordeals the majority of people undergo is the ideological prevalence of disbelief. This state can only be ended with the ideological defeat of disbelief and by conveying the wonders of creation and Qur'anic morality so that people can live by it. Considering the state of the world today, which leads people into the downward spiral of violence, corruption and conflict, it is clear that this service has to be provided more speedily and effectively. Otherwise, it may be too late.

It is no exaggeration to say that the collection of books by Harun Yahya have assumed this leading role. By

the will of God, these books will be a means through which people in the 21st century will attain the peace, justice and happiness promised in the Qur'an.

The works of the author include *The New Masonic Order, Judaism and Freemasonry, Global Freemasonry, Kabbalah and Freemasonry, Knight Templars, Philosophy of Zionism, Kabbalah and Zionism, Islam Denounces Terrorism, Terrorism: The Ritual of the Devil, The Disasters Darwinism Brought to Humanity, Communism in Ambush, Fascism: The Bloody Ideology of Darwinism, The 'Secret Hand' in Bosnia, Behind the Scenes of The Holocaust, Behind the Scenes of Terrorism, Israel's Kurdish Card, The Oppression Policy of Communist China and Eastern Turkestan,Palestine, Solution: The Values of the Qur'an, The Winter of Islam and Its Expected Spring, Articles 1-2-3, A Weapon of Satan: Romanticism, The Light of the Qur' an Destroyed Satanism, Signs from the Chapter of the Cave to the Last Times, Signs of the Last Day, The Last Times and The Beast of the Earth, Truths 1-2, The Western World Turns to God, The Evolution Deceit, Precise Answers to Evolutionists, The Blunders of Evolutionists, Confessions of Evolutionists, The Misconception of the Evolution of the Species, The Qur'an Denies Darwinism, Perished Nations, For Men of Understanding, The Prophet Musa, The Prophet Yusuf, The Prophet Muhammad (saas), The Prophet Sulayman, The Golden Age, Allah's Artistry in Colour, Glory is Everywhere, The Importance of the Evidences of Creation, The Truth of the Life of This World, The Nightmare of Disbelief, Knowing the Truth, Eternity Has Already Begun, Timelessness and the Reality of Fate, Matter: Another Name for Illusion, The Little Man in the Tower, Islam and the Philosophy of Karma, The Dark Magic of Darwinism, The Religion of Darwinism, The Collapse of the Theory of Evolution in 20 Questions, Engineering in Nature, Technology Mimics Nature, The Impasse of Evolution I (Encyclopedic), The Impasse of Evolution II (Encyclopedic), Allah is Known Through Reason, The Qur'an Leads the Way to Science, The Real Origin of Life, Consciousness in the Cell, Technology Imitates Nature, A String of Miracles, The Creation of the Universe, Miracles of the Qur'an, The Design in Nature, Self-Sacrifice and Intelligent Behaviour Models in Animals, The End of Darwinism, Deep Thinking, Never Plead Ignorance, The Green Miracle: Photosynthesis, The Miracle in the Cell, The Miracle in the Eye, The Miracle in the Spider, The Miracle in the Gnat, The Miracle in the Ant, The Miracle of the Immune System, The Miracle of Creation in Plants, The Miracle in the Atom, The Miracle in the Honeybee, The Miracle of Seed, The Miracle of Hormone, The Miracle of the Termite, The Miracle of the Human Body, The Miracle of Man's Creation, The Miracle of Protein, The Miracle of Smell and Taste, The Miracle of Microworld, The Secrets of DNA.*

The author's childrens books are: *Wonders of Allah's Creation, The World of Animals, The Glory in the Heavens, Wonderful Creatures, Let's Learn Our Islam, The Miracles in Our Bodies, The World of Our Little Friends: The Ants, Honeybees That Build Perfect Combs, Skillful Dam Builders: Beavers.*

The author's other works on Quranic topics include: *The Basic Concepts in the Qur'an, The Moral Values of the Qur'an, Quick Grasp of Faith 1-2-3, Ever Thought About the Truth?, Crude Understanding of Disbelief, Devoted to Allah, Abandoning the Society of Ignorance, The Real Home of Believers: Paradise, Knowledge of the Qur'an, Qur'an Index, Emigrating for the Cause of Allah, The Character of the Hypocrite in the Qur'an, The Secrets of the Hypocrite, The Names of Allah, Communicating the Message and Disputing in the Qur'an, Answers from the Qur'an, Death Resurrection Hell, The Struggle of the Messengers, The Avowed Enemy of Man: Satan, The Greatest Slander: Idolatry, The Religion of the Ignorant, The Arrogance of Satan, Prayer in the Qur'an, The Theory of Evolution, The Importance of Conscience in the Qur'an, The Day of Resurrection, Never Forget, Disregarded Judgements of the Qur'an, Human Characters in the Society of Ignorance, The Importance of Patience in the Qur'an, General Information from the Qur'an, The Mature Faith, Before You Regret, Our Messengers Say, The Mercy of Believers, The Fear of Allah, Jesus Will Return, Beauties Presented by the Qur'an for Life, A Bouquet of the Beauties of Allah 1-2-3-4, The Iniquity Called "Mockery," The Mystery of the Test, The True Wisdom According to the Qur'an, The Struggle Against the Religion of Irreligion, The School of Yusuf, The Alliance of the Good, Slanders Spread Against Muslims Throughout History, The Importance of Following the Good Word, Why Do You Deceive Yourself?, Islam: The Religion of Ease, Zeal and Enthusiasm Described in the Qur'an, Seeing Good in All, How do the Unwise Interpret the Qur'an?, Some Secrets of the Qur'an, The Courage of Believers, Being Hopeful in the Qur'an, Justice and Tolerance in the Qur'an, Basic Tenets of Islam, Those Who do not Listen to the Qur'an, Taking the Qur'an as a Guide, A Lurking Threat: Heedlessness, Sincerity in the Qur'an, The Religion of Worshipping People, The Methods of the Liar in the Qur' an, The Happiness of Believers*

contents

10 INTRODUCTION

1. WHY IS THE THEORY OF EVOLUTION NOT SCIENTIFICALLY VALID? 12

2. HOW DOES THE COLLAPSE OF THE THEORY OF EVOLUTION DEMONSTRATE THE TRUTH OF CREATION? 20

3. HOW FAR BACK DO TRACES OF MAN GO? WHY DO THESE NOT SUPPORT EVOLUTION? 29

4. WHY IS THE THEORY OF EVOLUTION "NOT THE BASIS OF BIOLOGY"? 40

5. WHY IS THE EXISTENCE OF DIFFERENT RACES NOT EVIDENCE FOR EVOLUTION? 41

6. WHY IS THE CLAIM THAT HUMAN AND APE GENOMES ARE 99 PERCENT SIMILAR AND THAT THIS CONFIRMS EVOLUTION NOT TRUE? 45

7. WHY IS THE CLAIM THAT DINOSAURS EVOLVED INTO BIRDS AN UNSCIENTIFIC MYTH? 51

8. WHAT SCIENTIFIC FORGERY IS THE MYTH THAT "HUMAN EMBRYOS HAVE GILLS" BASED ON? 68

9. WHY IS IT DECEPTIVE TO PORTRAY CLONING AS "EVIDENCE FOR EVOLUTION"? 74

10. COULD LIFE HAVE COME FROM OUTER SPACE? 79

11. WHY DOES THE FACT THAT THE EARTH IS FOUR BILLION YEARS OLD NOT SUPPORT THE THEORY OF EVOLUTION? 86

12. WHY ARE WISDOM TEETH NOT EVIDENCE OF EVOLUTION? 92

13. HOW DO THE COMPLEX STRUCTURES OF THE MOST ANCIENT CREATURES DEMOLISH THE THEORY OF EVOLUTION? 96

14. WHY IS DENYING THE THEORY OF EVOLUTION PORTRAYED AS REJECTING DEVELOPMENT AND PROGRESS? 104

15. WHY IS IT MISTAKEN TO THINK THAT GOD COULD HAVE CREATED LIVING THINGS BY EVOLUTION? 108

16. WHY IS IT WRONG TO THINK THAT EVOLUTION COULD BE CONFIRMED IN THE FUTURE? 113

17. WHY IS METAMORPHOSIS NOT EVIDENCE OF EVOLUTION? 120

18. WHY IS IT IMPOSSIBLE TO ACCOUNT FOR DNA BY "CHANCE"? 124

19. WHY IS IT THAT BACTERIAL RESISTANCE TO ANTIBIOTICS IS NOT AN EXAMPLE OF EVOLUTION? 130

20. WHAT KIND OF RELATIONSHIP IS THERE BETWEEN CREATION AND SCIENCE? 135

144 NOTES



INTRODUCTION

THE THEORY OF EVOLUTION has been around for 150 years, and has had a great influence on the way people look at the world. It proposes the lie that they came into this world as the result of chance and that they are a "species of animal." Furthermore, it teaches them that the only law in life is a selfish struggle for survival and to stay alive. The effects of this idea can be clearly seen in the nineteenth and twentieth centuries: people's increasing selfishness, the moral degeneration in society, the rapid spread of self-interest, ruthlessness, and violence, the development of totalitarian and bloody ideologies such as fascism and communism, social and individual crises as people grow distant from the morality of religion,…

The social results of the theory of evolution have been examined in other books of this author. (see Harun Yahya's *The Disasters Darwinism Brought to Humanity, Communism Lies in Ambush, The Black Magic of Darwinism*, and *The Religion of Darwinism*). It is revealed in these books that this theory, which claims to be "scientific," actually has no scientific basis at all, that it is a scenario stubbornly defended in the face of all the facts, consisting of nothing but superstitions.

It is essential that those who wish to learn about the true nature of the theory of evolution and the Darwinian "world-view" that has systematically dragged the world towards violence, savagery, ruthlessness, and conflict for the last 150 years turn to those books.

This book will consider the invalidity of the theory of evolution at a more general level. Evolutionists' claims on certain matters will be responded to with questions that are frequently asked, the meanings of which are not entirely understood. The answers provided in this book can be found in more scientific detail in those of this author's books such as *The Evolution Deceit*, and *Darwinism Refuted*.



WHY IS THE THEORY OF EVOLUTION NOT SCIENTIFICALLY VALID?

THE theory of evolution maintains that life on Earth came about as the result of chance and emerged by itself from natural conditions. This theory is not a scientific law or a proven fact. Underneath its scientific façade it is a materialist worldview that Darwinists are trying to impose on society. The bases of this theory, which has been disproved by science in every field, are suggestions and propaganda methods consisting of deceptions, falsehood, contradiction, cheating, and sleight of hand.

The theory of evolution was put forward as an imaginary hypothesis in the context of the primitive scientific understanding of the nineteenth century, and to this day it has not been backed up by any scientific discovery or experiment. On the contrary, all the methods employed to confirm the theory

have merely proven its invalidity.

However, even today many people think that the theory is a proven fact, like the force of gravity or the law of buoyancy. Because, as stated at the beginning, the true nature of the theory of evolution is very different from what is usually supposed. For this reason, some people do not know what rotten foundations this theory has, how it is disproved by science at every turn, and how evolutionists are trying to keep it alive in its death throes. Evolutionists have no other support than unconfirmed hypotheses, biased and unrealistic observations, and imaginary drawings, methods of psychological suggestion, countless falsehoods, and sleight-of-hand techniques.

Today, such branches of science as paleontology, genetics, biochemistry, and molecular biology have proven that it is quite impossible for life to come about as a result of chance and to emerge by itself from natural conditions. The living cell, it is commonly agreed by the world of science, is the most complex structure that mankind has so far encountered. Modern science has revealed that just one living cell has a much more complex structure and mutually interconnected complicated systems than a large city. Such a complex structure can only function if all its separate parts emerge at the same time and in full working order. Otherwise, it will serve no purpose, and will fall apart over time and disappear. We cannot expect that its parts developed by chance over millions of years as claimed by the theory of evolution. For that reason, the complex design in just one cell clearly shows that God created life. (For more details, see Harun Yahya, *The Miracle in the Cell*)

However, those who defend materialist philosophy do not want to accept the fact of creation for various ideological reasons. That is because the existence and spread of societies living in the light of that beautiful morality that true religion offers to man by means of God's commands and prohibitions is not in these materialists' interests. Masses devoid of any spiritual and moral values suit these people far better, since they can manipulate them for their own worldly interests. For this reason, they try to impose the theory of evolution, which encourages the lie that mankind was not created but rather emerged by chance and evolved from animals, and to keep it alive at whatever costs. Despite all the clear scientific proof that destroys the theory of evolution and confirms the fact of creation, they abandon all reason and logic and defend this nonsense at every available opportunity.

It has actually been proved that it is impossible for the first living cell, or even just one of the millions of protein molecules in that cell, to have come about by chance. This has been demonstrated not only by experiments and observations, but also by mathematical calculations of probability. In other words, evolution collapses at the very first step: that of explaining the emergence of the first living cell.

Not only could the cell, the smallest unit of life, never have come about by chance in the primitive and uncontrolled conditions in the early days of the Earth, as evolutionists would have us believe, it cannot even be synthesized in the most advanced laboratories of the twentieth century. Amino acids, the building blocks of the proteins that make up the living cell, cannot of themselves build such organelles in the cell

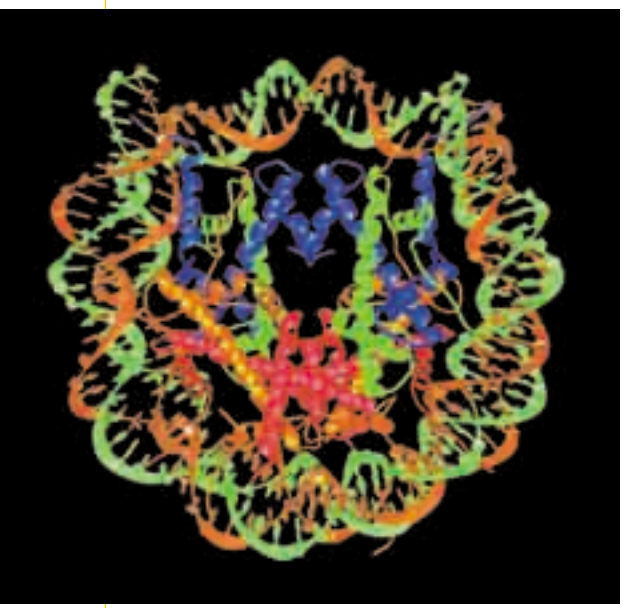


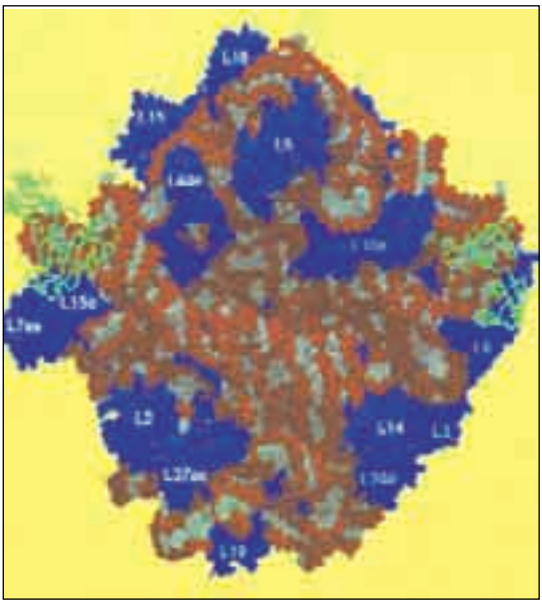
Nothing was known in Darwin's time about the complex structure of the cell.

as mitochondria, ribosomes, cell membranes, or the endoplasmic reticulum, let alone a whole cell. For this reason, the claim that evolution brought about the first cell by chance remains the product of a fantasy based entirely on imagination.

The living cell, which still harbours many secrets that have not been explained, is one of the major difficulties facing the theory of evolution.

Another terrible dilemma from the point of view of evolution is the DNA molecule in the nucleus of the living cell, a coding system with 3.5 billion units containing all the details of life. DNA was first discovered using X-ray crystallography in the late 1940s and early 1950s, and is a giant molecule with





Examples of the complex structures in cells: Right, a ribosome where the protein synthesis takes place in the cell. Left, a "nucleosome" which packages DNA units in the chromosome. The cell contains many very complex structures and systems such as these, and even more complex ones. The realisation that these complex structures, discovered by technology as it advanced, could not have come about by chance has placed evolutionists in a dilemma they can never solve.

a superb plan and design. For many years, Francis Crick, a Nobel-prize laureate, believed in the theory of molecular evolution, but eventually even he had to admit to himself that such a complex molecule could not have emerged spontaneously by chance, as the result of an evolutionary process:

> An honest man, armed with all the knowledge available to us now, could only state that, in some sense, the origin of life appears at the moment to be almost a miracle.[1]

The Turkish evolutionist Professor Ali Demirsoy was forced to make the following confession on the issue:

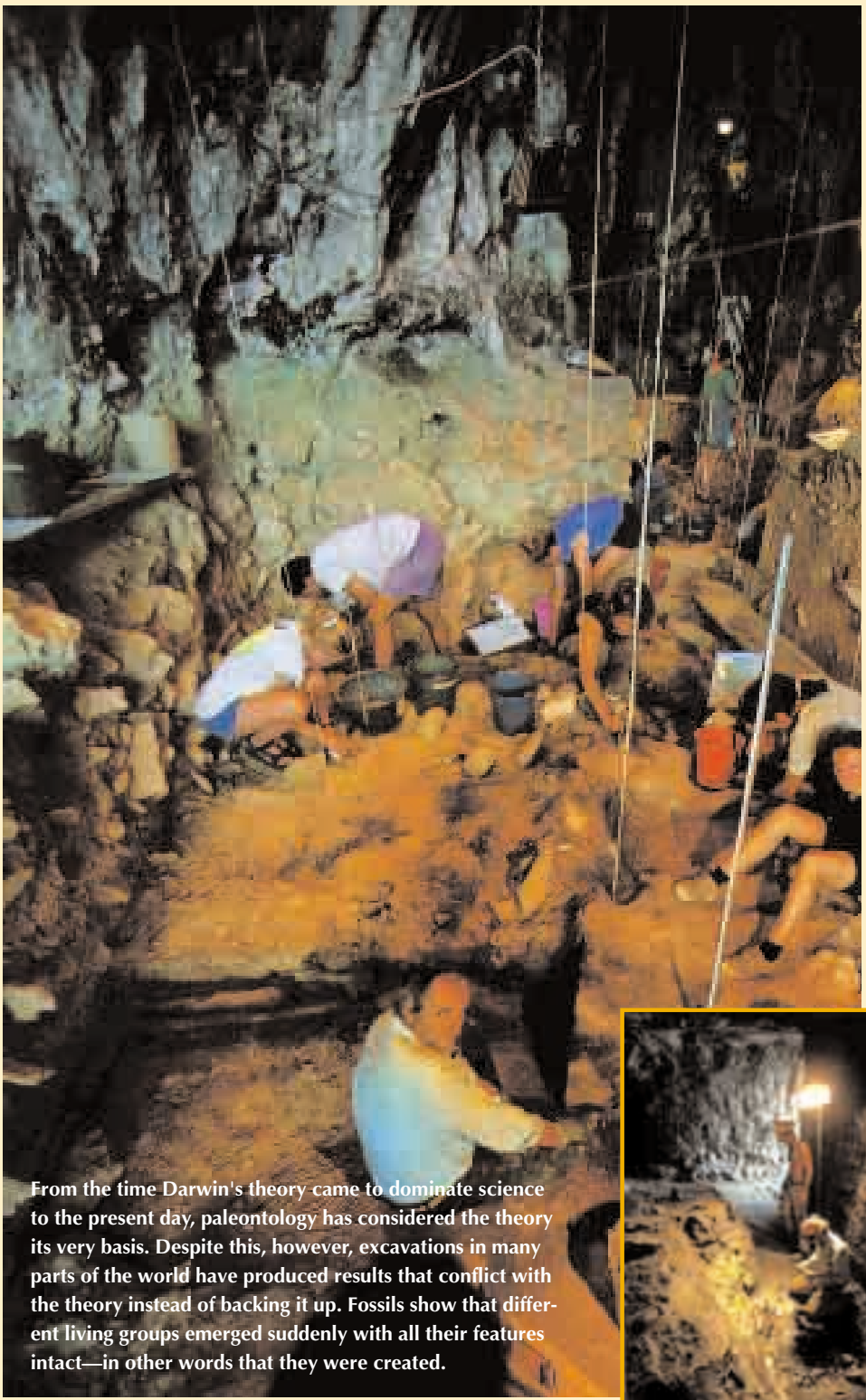

Francis Crick

In fact, the probability of the formation of a protein and a nucleic acid (DNA-RNA) is a probability way beyond estimating. Furthermore, the chance of the emergence of a certain protein chain is so slight as to be called astronomic. [2]

Homer Jacobson, Professor Emeritus of Chemistry, makes the following admission regarding how impossible it is for life to have come about by chance:

> Directions for the reproduction of plans, for energy and the extraction of parts from the current environment, for the growth sequence, and for the effector mechanism translating instructions into growth—all had to be simultaneously present at that moment [when life began]. This combination of events has seemed an incredibly unlikely happenstance… [3]

The fossil record represents another crushing defeat for the theory of evolution. Among all the fossils discovered over the years, there is not one trace of the intermediate forms that would be necessary if living things were to have evolved stage by stage from simple species to more complex ones, as the theory of evolution claims. If such creatures had really existed, there would have been millions, even billions, of them. More importantly, the remains of these creatures should be present in the fossil record. If these intermediate forms had ever really existed, their numbers would be even greater than the number of animal species we know today, and everywhere the world should be full of their fossil remains. Evolutionists look for



From the time Darwin's theory came to dominate science to the present day, paleontology has considered the theory its very basis. Despite this, however, excavations in many parts of the world have produced results that conflict with the theory instead of backing it up. Fossils show that different living groups emerged suddenly with all their features intact—in other words that they were created.

these intermediate forms in all the feverish fossil research that has been carried out since the nineteenth century. However, there has been no trace of these intermediate forms, despite all the eager searching for the last 150 years.

In short, the fossil record shows that living species emerged suddenly and perfectly formed, not by following a process from primitive forms to advanced ones as evolution claims.

Evolutionists have tried very hard to find evidence for their theory or so, but have actually proved by their own hand that no evolutionary process could have been possible. In conclusion, modern science reveals the following indisputable fact: **Living things did not emerge as the result of blind chance, but God created them.**



Twenty-five-million-year-old termites preserved in amber. They are indistinguishable from termites living in our time.



HOW DOES THE COLLAPSE OF THE THEORY OF EVOLUTION DEMONSTRATE THE TRUTH OF CREATION?

WHEN we ask how life on Earth emerged, we find two different answers: One is that living things emerged by evolution. According to the theory of evolution, which makes this claim, life began with the first cell, which itself emerged by chance or by some hypothetical natural laws of "self-organization." Again as a result of chance and natural laws, this living cell developed and evolved, and by taking on different forms gave rise to the millions of species of life on Earth.

The second answer is "Creation." All living things came into existence by being created by an intelligent Creator. When life and the millions of forms it takes, which could not possibly have come into existence by chance, were first created, they had the same complete, flawless, and superior design that they pos-

sess today. The fact that even the simplest-looking forms of life possess such complex structures and systems that could never have come about by chance and natural conditions is a clear proof of this.

Outside these two alternatives, there is no third claim or hypothesis today regarding how life emerged. According to the rules of logic, if one answer to a question with two alternative possible answers is proved to be false, then the other must be true. This rule, one of the most fundamental in logic, is called disjunctive inference (*modus tollendo ponens*).

In other words, if it is demonstrated that living species on Earth did not evolve by chance, as the theory of evolution claims, then that is clear proof that they were formed by a Creator. Scientists who support the theory of evolution agree that there is no third alternative. One of these, Douglas Futuyma, makes the following statement:

> Organisms either appeared on the earth fully developed or they did not. If they did not, they must have developed from pre-existing species by some process of modification. If they did appear in a fully developed state, they must indeed have been created by some omnipotent intelligence. [4]

The fossil record provides the answer to the evolutionist Futuyma. The science of fossils (paleontology) shows that all living groups emerged on Earth at different times, all at once, and perfectly formed.

All the discoveries from excavations and studies over the last hundred years or so show that, contrary to evolutionists' expectations, living things came into existence suddenly, in perfect and flawless form, in other words that they were "created." Bacteria, protozoa, worms, molluscs, and other invertebrate sea creatures, arthropods, fish, amphibians, reptiles, birds, and

mammals all appeared suddenly, with complex organs and systems. There are no fossils that show any so-called "transition" between them. Paleontology bears the same message as other branches of science: Living things did not evolve, but were created. As a result, while evolutionists were trying to prove their unrealistic theory, they by their own hands produced proof of creation.

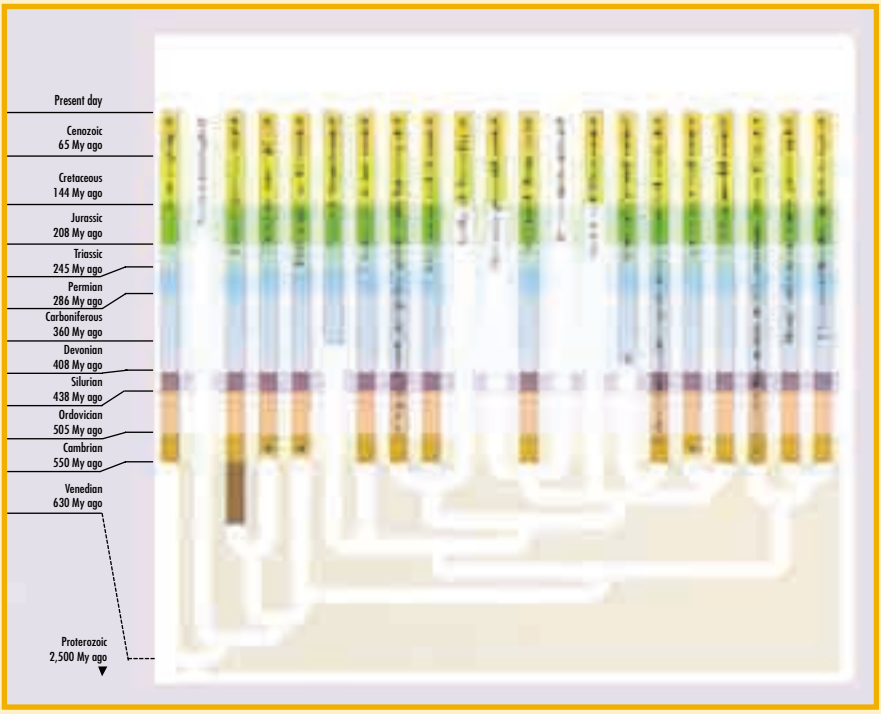
Robert Carroll, an expert on vertebrate paleontology and a committed evolutionist, comes to admit that the Darwinist hope has not been satisfied with fossil discoveries:

> Despite more than a hundred years of intense collecting efforts since the time of Darwin's death, the fossil record still does not yield the picture of **infinitely numerous transitional links** that he expected. [5]

The Cambrian Explosion is enough to tear down the theory of evolution

The world of living things is divided by biologists into such fundamental groups as plants, animals, fungae etc. These are then subdivided into different "phyla." When designating these phyla, the fact that each one possesses completely different physical structures should always be borne in mind. *Arthropoda* (insects, spiders, and other creatures with jointed legs), for instance, are a phylum by themselves, and all the animals in the phylum have the same fundamental physical structure. The phylum called *Chordata* includes those creatures with a notochord or, most commonly, a spinal column. All the large animals such as fish, birds, reptiles, and mammals that we are familiar in daily life are in a subphylum of *Chordata* known as vertebrates.

There are around 35 different phyla of animals, including



THE CAMBRIAN EXPLOSION TEARS UP THE EVOLUTIONARY "TREE OF LIFE"

The above illustration is taken from *The Book of Life*, published in 2001 under the editorship of the late Stephen Jay Gould, one of the world's most prominent evolutionists. The illustration explains which different groups of animals emerged in which periods. On the left, the various geological periods are listed, starting 2,500 million years ago. The coloured columns show the major phyla of animals. (The colours in the columns refer to different periods.)

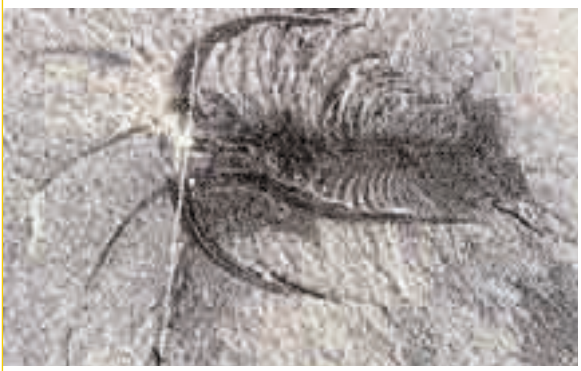


When we examine this figure, the miracle of the Cambrian Explosion is obvious. There is only one phylum before the Cambrian Age (the *Cnidaria*, which include jellyfish and corals). In the Cambrian Age, however, 13 completely different phyla suddenly emerged.

This picture is the opposite of the theory of evolution, because evolution maintains that living phyla increased in stages, like the branches of a tree.

The evolutionists who drew up the figure try to gloss over this gap by talking about "theoretical links." We can see pale lines at the bottom of the figure joining the coloured boxes (in other words, genuine phyla of which fossil remains have been found). These are imaginary links required by the theory of evolution, but of which no evidence has ever been found.

If the theory of evolution were true, if these links were real and not imaginary, then fossils of transitional groups should have been discovered. Despite all the fossil research of the last 150 years, the fact that these links are still just a dream shows that the theory of evolution is nothing but a fantasy.



Marrella: One of the interesting fossil creatures found in the Burgess Shale, a Cambrian rock formation



A fossil from the Cambrian Age.

the *Mollusca*, which include soft-bodied creatures such as snails and octopuses, or the *Nematoda*, which include diminutive worms. The most important feature of these phyla is, as we touched on earlier, that they possess totally different physical characteristics. The categories below the phyla possess basically similar body plans, but the phyla are very different from one another.

So how did these differences come about?

Let us first consider the Darwinist hypothesis. As we know, Darwinism proposes that life developed from one single common ancestor, and took on all its varieties by a series of tiny changes. In that case, life should first have emerged in very similar and simple forms. And according to the same theory, the differentiation between, and growing complexity in, living things must have happened in parallel over time.

According to Darwinism, life must be like a tree, with a common root, subsequently splitting up into different branches. And this hypothesis is constantly emphasized in Darwinist sources, where the concept of the "tree of life" is frequently employed. According to this tree concept, one phylum must first emerge, and then the other phyla must slowly come about with minute changes over very long periods of time.





INTERESTING SPINES:
***Hallucigenia*: One of the creatures that suddenly emerged in the Cambrian Age. This and many other Cambrian fossils have hard, sharp spines to protect them from attack. One thing that evolutionists cannot account for is how these creatures should have such an effective defense system when there were no predators around. The lack of predators makes it impossible to explain these spines in terms of natural selection.**

That is the theory of evolution's claim. But is this really how it happened?

Definitely not. Quite the contrary, animals have been very different and complex since the moment they first emerged. **All the animal phyla known today emerged at the same time, in the middle of the geological period known as the Cambrian Age.** The Cambrian Age is a geological period estimated to have lasted some 65 million years, approximately between 570 to 505 million years ago. But the period of the abrupt appearance of major animal groups fit in an even shorter phase of the Cambrian, often referred to as the "Cambrian explosion." Stephen C. Meyer, P. A. Nelson, and Paul Chien, in an article based on a detailed literature survey, dated 2001, note that the "Cambrian explosion occurred within an exceedingly narrow window of geologic time, lasting no more than 5 million years."[6]

Before then, there is no trace in the fossil record of anything apart from single-celled creatures and a few very primitive multicellular ones. All animal phyla emerged completely





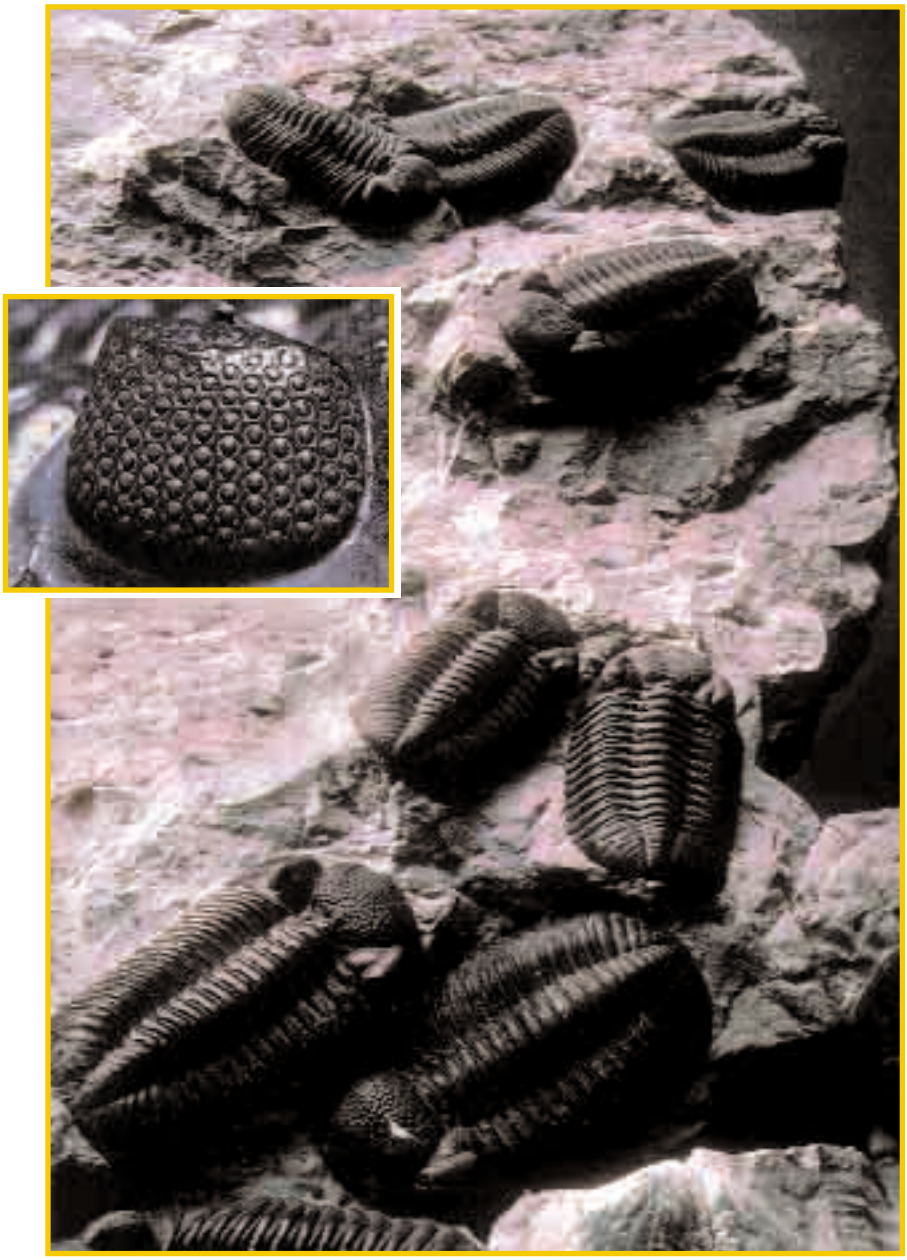
Many complex invertebrates such as starfish and jellyfish emerged suddenly some 500 million years ago with no so-called evolutionary ancestor before them. In other words, they were created. They were no different from those alive today.

formed and all at once, in the very short period of time represented by the Cambrian Explosion. (Five million years is a very short time in geological terms!)

The fossils found in Cambrian rocks belong to very different creatures, such as snails, trilobites, sponges, jellyfish, starfish, shellfish, etc. Most of the creatures in this layer have complex systems and advanced structures, such as eyes, gills, and circulatory systems, exactly the same as those in modern specimens. These structures are at one and the same time very advanced, and very different.

Richard Monastersky, a staff writer at *Science News* journal, states the following about the Cambrian explosion, which is a deathtrap for evolutionary theory:

> A half-billion years ago, **...the remarkably complex forms of animals we see today suddenly appeared.** This moment, right at the start of Earth's Cambrian Period, some 550 million years ago, marks the evolutionary explosion that filled



One of the complex invertebrates that suddenly emerged in the Cambrian Age some 550 million years ago were the fossil trilobites above. Another feature of trilobites that poses a quandary for evolutionists is their compound eye structure. Trilobites' very advanced eyes possessed a multi-lens system. That system is exactly the same as that found in many creatures today, such as spiders, bees, and flies. The sudden emergence of such a complex eye structure in a creature that lived 500 million years ago is enough on its own to consign evolutionists' theories based on chance to the waste bin.



Prof. Phillip Johnson

the seas with the world's first complex creatures.[7]

Phillip Johnson, a professor at the University of California at Berkeley who is also one of the world's foremost critics of Darwinism, describes the contradiction between this paleontological truth and Darwinism:

> Darwinian theory predicts a "cone of increasing diversity," as the first living organism, or first animal species, gradually and continually diversified to create the higher levels of taxonomic order. The animal fossil record more resembles such a cone turned upside down, with t**he phyla present at the start and thereafter decreasing**. [8]

As Phillip Johnson has revealed, far from its being the case that phyla came about by stages, in reality they all came into being at once, and some of them even became extinct in later periods. The meaning of the emergence of very different living creatures all of a sudden and perfectly formed, is creation, as evolutionist Futuyma has also accepted. As we have seen, all the available scientific discoveries disprove the claims of the theory of evolution and reveal the truth of creation.



HOW FAR BACK DO TRACES OF MAN GO? WHY DO THESE NOT SUPPORT EVOLUTION?

WE need to turn to the fossil record to find an answer to the question of when man appeared on Earth. This record shows that man goes back millions of years. These discoveries consist of skeletons and skulls, and the remains of people who lived at various times. One of the oldest traces of man are the "footprints" found by the famous palaeontologist Mary Leakey in 1977 in Tanzania's Laetoli region.

These remains caused a great furore in the world of science. Research indicated that these footprints were in a 3.6-million-year-old layer. Russell Tuttle, who saw the footprints, wrote:

> A small barefoot *Homo sapiens* could have made them... In all discernible morphological features, the feet of the individuals that made the trails are indistinguishable from those of modern humans. [9]



3.6-million-year-old human footprints found in Laetoli, Tanzania.

Impartial examinations of the footprints revealed their real owners. In reality, these footprints consisted of 20 fossilized footprints of a 10-year-old modern human and 27 footprints of an even younger one. Such famous paleoanthropologists as Don Johnson and Tim White, who examined the prints found by Mary Leakey, corroborated that conclusion. White revealed his thoughts by saying:

> Make no mistake about it,... They are like modern human footprints. If one were left in the sand of a California beach today, and a four-year old were asked what it was, he would instantly say that somebody had walked there. He wouldn't be able to tell it from a hundred other prints on the beach, nor would you. [10]

These footprints sparked an important debate among evolutionists. That was because for them to accept that these were human footprints would mean that the imaginary progression they had drawn up from ape to man could no longer be maintained. However, at this point dogmatic evolutionist logic once again showed its face. Most evolutionist scientists once more abandoned science for the sake of their prejudices. They claimed that the footprints found at Laetoli were those of an ape-like creature. Russell Tuttle, who was one of the evolutionists defending this claim, wrote:

> In sum, the 3.5 million-year-old footprint traits at Laetoli site G resemble those of habitually unshod modern humans. None of their features suggest that the Laetoli hominids were less capable bipeds than we are. If the G footprints were not known to be so old, we would readily conclude that there were made by a member of our genus *Homo*... In any case, we should shelve the loose assumption that the Laetoli footprints were made by Lucy's kind, *Australopithecus afarensis*. [11]

Another of the oldest remains to do with man was the ruins of a stone hut found in the Olduvai Gorge region by Louis Leakey in the 1970s. The remains of the hut were found in a layer 1.7 million years old. It is known that structures of this kind, of which similar examples are still used in Africa in the present day, could only be built by *Homo sapiens*, in other words modern man. The significance of the remains is that they reveal that man lived at the same time as the so-called ape-like creatures that evolutionists portray as his ancestors.

A 2.3 million-year-old modern human jaw found in the Hadar region of Ethiopia was very important from the point of view of showing that modern man had existed on the Earth much longer that evolutionists expected.[12]

One of the oldest and most perfect human fossils is KNM-WT 1500, also known as the "Turkana Child" skeleton. The 1.6 million-year-old fossil is described by the evolutionist Donald Johanson in these terms:

> He was tall and thin, in body shape and limb proportions resembling present-day equatorial Africans. Despite his youth, the boy's limb nearly matched the mean measurements for white North American adult males. [13]



The remains of a 1.7-million-year-old stone hut.

It is confirmed that the fossil was that of a 12-year-old boy, who would have been 1.83 metres tall in adolescence. The American paleoanthropologist Alan Walker said that he doubted that "the average pathologist could tell the difference between the fossil skeleton and that of a modern human." Concerning the skull, Walker wrote that he laughed when he saw it because "it looked so much like a Neanderthal."[14]

One of the human fossils that has attracted the most attention was one found in Spain in 1995. The fossil in question was uncovered in a cave called Gran Dolina in the Atapuerca region of Spain by three

Spanish paleoanthropologists from the University of Madrid. The fossil revealed the face of an 11-year-old boy who looked entirely like modern man. Yet, it had been 800,000 years since the child died. This fossil even shook the convictions of Juan Luis Arsuaga Ferreras, who lead the Gran Dolina excavation. Ferreras said:

> We expected something big, something large, something inflated–you know, something primitive… Our expectation of an 800,000-year-old boy was something like Turkana Boy. And what we found was a totally modern face.... To me this is most spectacular–these are the kinds of things that shake you. Finding something totally unexpected like that. Not finding fossils; finding fossils is unexpected too, and it's okay. But the most spectacular thing is finding something you thought belonged to the present, in the past. It's like finding something like–like a tape recorder in Gran Dolina. That would be very surprising. We don't expect cassettes and tape recorders in the Lower Pleistocene. Finding a modern face 800,000 years ago–it's the same thing. We were very surprised when we saw it. [15]



In its December 1997 edition, *Discover*, one of the most popular evolutionist magazines, placed an 800,000-year-old human face on its cover, alongside a headline taken from evolutionists' surprised statement, "Is this the face of our past?"

As we have seen, fossil discoveries give the lie to the claim of "the evolution of man." This claim is presented by some media organizations as if it were a proven fact, whereas all that actually exist are fictitious theories. In fact, evolutionist scientists accept this, and admit that the claim of "the evolution of man" lacks any scientific evidence.

For instance, by saying, "We appear suddenly in the fossil record" the evolutionist paleontologists C. A. Villie, E. P. Solomon and P. W. Davis admit that man emerged all of a sudden, in other words with no evolutionary ancestor.[16]

Mark Collard and Bernard Wood, two evolu-

EVOLUTIONISTS' VOLTE-FACE REGARDING THE NEANDERTHALS

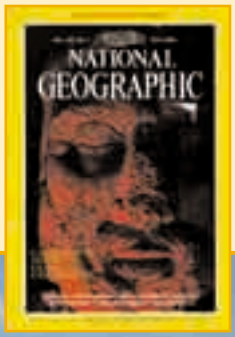
1975 PORTRAYAL OF NEANDERTHALS - Geheimnisse der Urzeit, Deutsche Übersetzung, 1975



Since the beginning of the twentieth century, evolutionists have been portraying the Neanderthals, a vanished human race, as semi-ape creatures. The above portrayal of Neanderthals was used as evolutionist propaganda for decades. However, since the 1980s this myth has begun to collapse. Both fossil studies and traces of

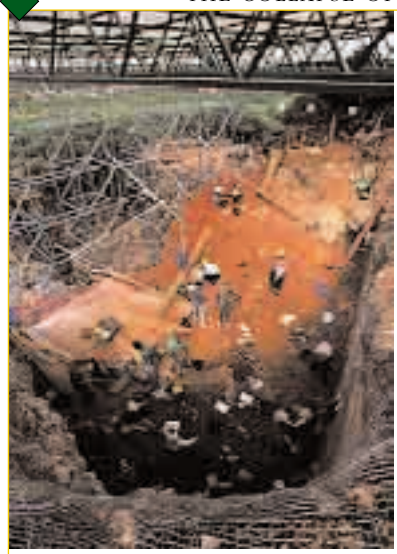


Neanderthal culture have shown that these people were not semi-apes. For example, this 26,000-year-old needle proved that Neanderthals were civilised humans who possessed the ability to sew. As a result of this, evolutionist publications such as *National Geographic* had to start portraying them as civilised, as in the picture below.





2000 PORTRAYAL OF NEANDERTHALS - *National Geographic*, July 2000





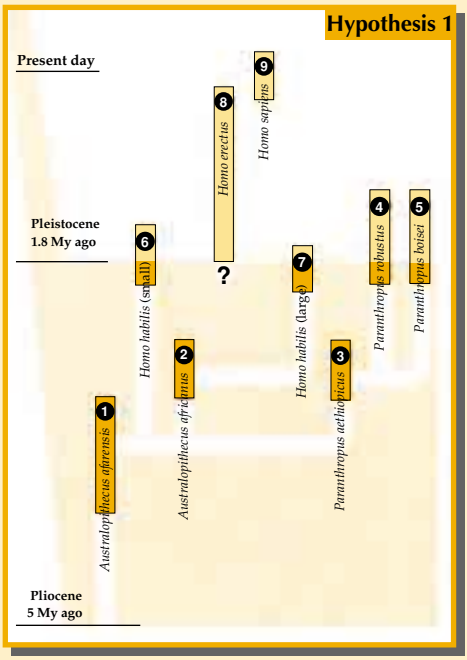
The Gran Dolina cave in Spain, where the Atapuerca fossil, of a true human being, was found.

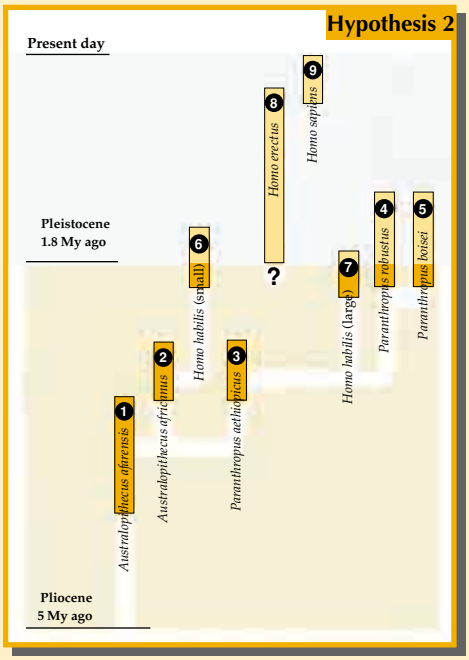
tionist anthropologists were forced to say, **"existing phylogenetic hypotheses about human evolution are unlikely to be reliable."** in an article they wrote in 2000. [17]

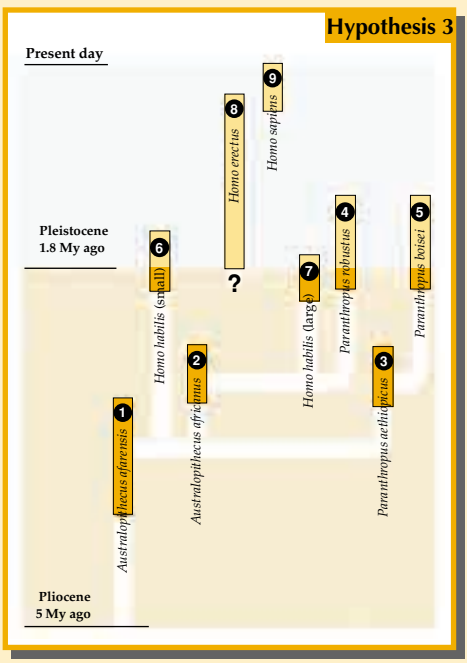
Every new fossil discovery places evolutionists in an even worse quandary, even if certain frivolous newspapers do print headlines such as "Missing link discovered." The fossil skull discovered in 2001 and named *Kenyanthropus platyops* is the latest example of this. The evolutionist paleontologist Daniel E. Lieberman from Washington University's Department of Anthropology had this to say about *Kenyanthropus platyops* in an article in the leading scientific journal, *Nature*:

> The evolutionary history of humans is complex and unresolved. **It now looks set to be thrown into further confusion by the discovery of another species and genus, dated to 3.5 million years ago**… The nature of *Kenyanthropus platyops* raises all kinds of questions, about human evolution in general and the behaviour of this species in particular. Why, for example, does it have the unusual combination of small cheek teeth and a big flat face with an anteriorly positioned arch of the cheekbone? All other known hominin species with big faces and similarly positioned cheekbones have big teeth. **I suspect the chief role of *K. platyops* in the next few years will be to act as a sort of party**

EVOLUTIONISTS' IMAGINARY HYPOTHESES ARE FAR FROM ACCOUNTING FOR THE ORIGIN OF MAN







Despite 150 years of propagandistic evolutionist research into the origin of man, the fossils discovered show that the first human beings suddenly appeared on the Earth, with no "ape-like ancestor." The three different hypotheses on this page illustrate three different and contradictory evolutionist scenarios (Stephen Jay Gould, *The Book of Life*, 2001). Looking carefully, we can see that there is a question mark in front of *Homo erectus*, which is shown as the first human race on Earth. The reason for this is that there is no "ape-like" creature that evolutionists can show as being the "ancestor of man." Species in the illustrations, which lack anything linking them to man, are actually extinct species of ape. The origin of man, as we can see, is a mystery for evolutionists, because that origin is not evolution at all, but creation.

> **spoiler, highlighting the confusion that confronts research into evolutionary relationships among hominins.** [18]

The latest evidence to shatter the evolutionary theory's claim about the origin of man is the new fossil *Sahelanthropus tchadensis* unearthed in the Central African country of Chad in the summer of 2002.

The fossil has set the cat among the pigeons in the world of Darwinism. In its article giving news of the discovery, the world-renowned journal *Nature* admitted that "New-found skull could sink our current ideas about human evolution."[19]

Daniel Lieberman of Harvard University said that "This [discovery] will have the impact of a small nuclear bomb." [20]

The reason for this is that although the fossil in question is 7 million years old, it has a more "human-like" structure (according to the criteria evolutionists have hitherto used) than the 5 million-year-old *Australopithecus* ape species that is alleged to be "mankind's oldest ancestor." This shows that the evolutionary links established between extinct ape species based on the highly subjective and prejudiced criterion of "human similarity" are totally imaginary.

John Whitfield, in his article "Oldest Member of Human Family Found" published in *Nature* on July, 11, 2002, confirms this view quoting from Bernard Wood, an evolutionist anthropologist from George Washington University in Washington:

> "When I went to medical school in 1963, human evolution looked like a ladder." he [Bernard Wood] says. The ladder stepped from monkey to man through a progression of intermediates, each slightly less ape-like than the last. Now human evolution looks like a bush. We have a menagerie of fossil hominids... How they are related to each other and which, if any of them, are human forebears is still debated.[21]

The comments of Henry Gee, the senior editor of *Nature* and a leading paleoanthropologist, about the newly discovered ape fossil are very noteworthy. In his article published in *The Guardian*, Gee refers to

the debate about the fossil and writes:

> Whatever the outcome, the skull shows, once and for all, that the old idea of a "missing link" is bunk... It should now be quite plain that the very idea of the missing link, always shaky, is now completely untenable. [22]

As we have seen, the increasing number of discoveries is producing results opposed to the theory of evolution, not in favour of it. If such an evolutionary process had happened in the past, there should be many traces of it, and each new discovery should further strengthen the theory. In fact, in *The Origin of Species*, Darwin claimed that science would develop in just that direction. In his view, the only problem facing his theory in the fossil record was a lack of fossil discoveries. He hoped that future research would unearth countless fossils to support his theory. However, subsequent scientific discoveries have actually proved Darwin's dreams to be totally unfounded.

The importance of human-linked remains

The discoveries regarding man, of which we have seen a few examples here, reveal very important truths. In particular, they have once again demonstrated what a great product of fantasy the evolutionists' claim that man's ancestor was an ape-like creature is. For this reason, it is out of the question that these ape species could be man's ancestors.

In conclusion, the fossil record shows us that man came into existence millions of years ago in just the same form as he is now, and that he has come down to the present with absolutely no evolutionary development. If they claim to be genuinely scientific and honest, evolutionists should throw their imaginary progression from ape to man into the bin at this point. The fact that they do not give up this spurious family tree shows that evolution is not a theory that is defended in the name of science, but rather a dogma they are struggling to keep alive in the face of the scientific facts.



WHY IS THE THEORY OF EVOLUTION NOT THE "BASIS OF BIOLOGY"?

ONE claim that is frequently repeated by evolutionists is the lie that the theory of evolution is the basis of biology… Those who put forward this claim suggest that biology could not develop, or even exist, without the theory of evolution. This claim actually stems from a demagogy born out of despair. The philosopher Professor Arda Denkel, one of the foremost names in Turkish science, makes the following comment on this subject:

> For instance, it is quite wrong to suggest that "Rejecting the theory of evolution means rejecting the biological and geological sciences and the discoveries of physics and chemistry." Because in order to make such an inference (here *a modus tollens*) there need to be some propositions regarding chemical, physical, geological and biological discoveries that imply the theory of evolution. However, the discover-



During Stalin's rule in the Soviet Union, all scientific research had to conform to Marx and Engels' "dialectical materialism." Those who portray Darwinism as being the basis of biology have the same dogmatic mentality.

ies, or statements of them, do not imply the theory. Therefore, they do not prove it."[23]

It is enough to look at the history of science to realise what an invalid and irrational thing it is to claim that "evolution is the basis of biology." If the claim were true, it would mean that no biological sciences had developed in the world before the emergence of the theory of evolution, and that they were all born after it. However, many branches of biology, such as anatomy, physiology, and paleontology, were born and developed before the theory of evolution. On the other hand, evolution is a hypothesis that emerged after these sciences, which Darwinists are trying to impose on these sciences by force.

A similar method to that employed by evolutionists was used in the USSR in Stalin's time. In those days communism, the official ideology of the Soviet Union, considered the philosophy of "dialectical materialism" to be the basis of all the sciences. Stalin had ordered that all scientific research should conform to dialectical materialism. In this way, all books on biology, chemistry, physics, history, politics, and even art had introductory sections to the effect that those sciences were based on dialectical materialism and the views of Marx, Engels, and Lenin.

However, with the collapse of the USSR this obligation was lifted, and books returned to being ordinary technical, scientific texts containing the same information. The abandoning of such nonsense as dialectical materialism did not leave science in the shade, but rather lifted pressure and obligations from it.

In our day, there is no reason why science should remain tied to the theory of evolution. Science is based on observation and experimentation. Evolution, on the other hand, is a hypothesis regarding an unobservable past. Furthermore, the theory's claims and propositions have always been disproved by science and the laws of logic. Science will suffer no loss, of course, when this hypothesis is abandoned. The American biologist G. W. Harper has this to say on the subject:

> It is frequently claimed that Darwinism is central to modern biology. On the contrary, if all references to Darwinism suddenly disappeared, biology would remain substantially unchanged… [24]

In fact, quite to the contrary, science will progress in a much faster and healthier manner when it is freed from the insistence of a theory full of dogmatism, prejudice, nonsense, and fabrication.



WHY IS THE EXISTENCE OF DIFFERENT RACES NOT EVIDENCE FOR EVOLUTION?

SOME evolutionists try to put the existence of different races forward as evidence for evolution. In fact, this claim is more frequently expressed by amateur evolutionists who have a less than sufficient knowledge of the theory they defend.

The thesis proposed by those who defend this claim is based on the question, "If, as divine sources say, life began with one man and one woman, how could different races have emerged?" Another way of putting it is: "Since Adam and Eve's height, colour, and other features were those of only two people, how could races with entirely different features have emerged?"

In fact, the problem lying beneath all these questions or



Since the genetic material in the first man contained all the characteristics of the various races, parts of this came to dominate in various societies, and thus the human races formed.

objections is an insufficient knowledge of the laws of genetics, or the ignoring of them. In order to understand the reason for the differences between the races in today's world, it will be necessary to have some idea of the subject of "variation," which is closely linked to this question.

Variation, a term used in genetics, refers to a genetic event that causes the individuals or groups of a certain type or species to possess different characteristics from one another. The source of this variation is the genetic information possessed by the individuals within that species. As a result of breeding between those individuals, that genetic information comes together in later generations in different combinations. There is an exchange of genetic material between the mother's and father's chromosomes. Genes thus get mixed up with one another. The result of this is a wide variety of individual features.

The different physical features between human races are due to variations within the human race. All the people on Earth carry basically the same genetic information, yet some have slanted eyes, some have red hair, some have long noses, and others are short of stature, all depending on the extent of the variation potential of this genetic information.

In order to understand the variation potential, let us consider a society in which brunette, brown-eyed people predominate over

blond, blue-eyed individuals. As a result of the two communities intermingling and marrying over time, new generations which are brunette but blue-eyed will be seen. In other words, the physical characteristics of both groups will come together in subsequent generations and produce new appearances. When one imagines other physical characteristics mixing in the same way, it is clear that a great variety will emerge.

The important point that must be understood here is this: There are two genes that rule every physical feature. One may dominate the other, or they may both influence matters to an equal extent. For instance, two genes determine the colour of a person's eyes. One comes from the mother, the other from the father. Whichever gene is the dominant one, the individual's eye colour will be determined by that gene. In general, dark colours dominate lighter ones. In this way, if a person possesses genes for brown and for green eyes, his eyes will be brown because the brown eye gene is dominant. However, the recessive green colour can be passed down the generations and emerge at a later time. In other words, parents with brown eyes can have a green-eyed child. That is because that colour gene is recessive in both parents.

This law applies to all other physical features and the genes which govern them. Hundreds, or even thousands, of physical features, such as the ears, nose, the shape of the mouth, height, bone structure, and organ structure, shape, and characteristics, are all controlled in the same way. Thanks to this, all the limitless information in the genetic structure can be passed on to subsequent generations without becoming outwardly visible. Adam, the first human being, and Eve, were able to pass

the rich information in their genetic structure on to subsequent generations even though only a part of it was reflected in their physical appearance. Geographical isolation that had happened over human history has led to an atmosphere where different physical features came together in different groups. Over a long period of time, this led to different groups having different bone structures, skin colour, height, and skull volumes. This eventually led to the different races.

However, this long period did not change one thing, of course. No matter what their height, skin colour and skull volume, all races are part of the human species.



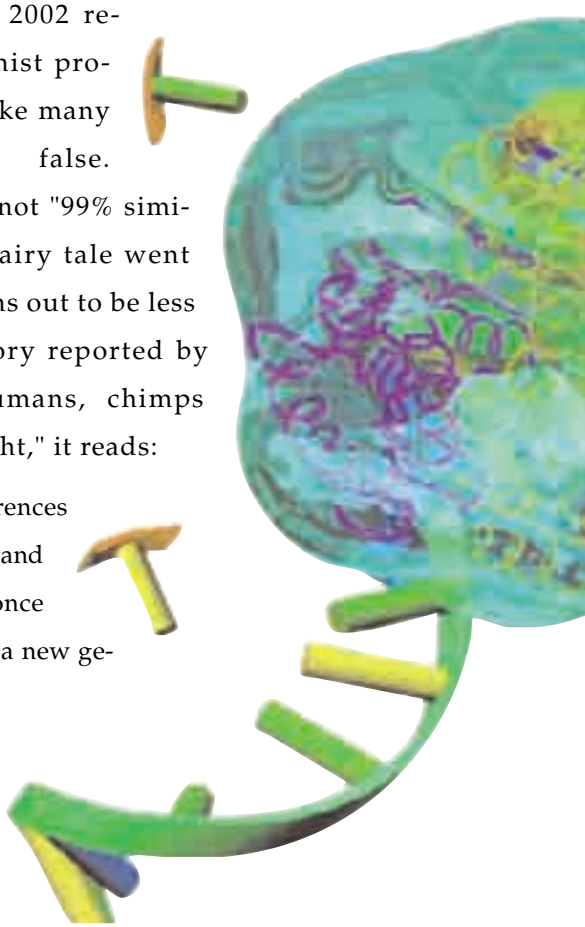
WHY IS THE CLAIM THAT HUMAN AND APE GENOMES ARE 99 PERCENT SIMILAR AND THAT THIS CONFIRMS EVOLUTION NOT TRUE?

MANY evolutionist sources from time to time carry the claim that humans and apes share 99 percent of their genetic information and that this is proof of evolution. This evolutionist claim focuses particularly on chimpanzees, and says that this creature is the closest monkey to man, for which reason there is a kinship between the two. However, this is a false proof put forward by evolutionists who take advantage of the layman's lack of information on these subjects.

99% similarity claim is misleading propaganda

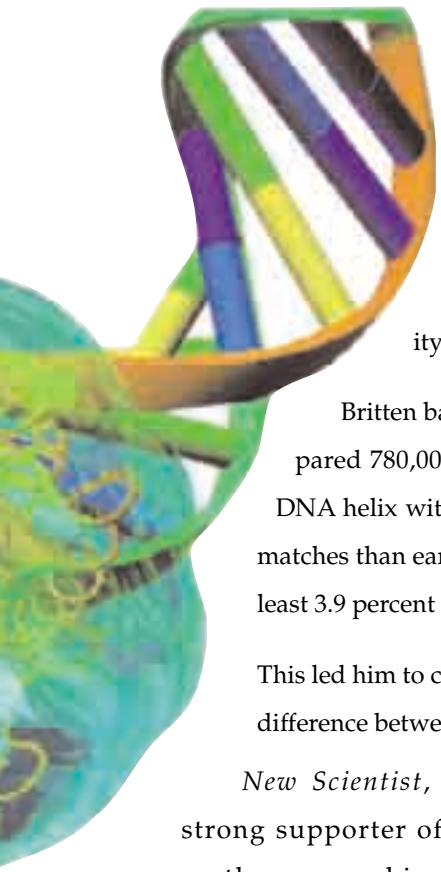
For a very long time, the evolutionist choir had been propagating the unsubstantiated thesis that there is very little genetic difference between humans and chimps. In every piece of evolutionist literature, you could read sentences like "we are 99 percent identical to chimps" or "there is only 1 percent of DNA that makes us human." Although no conclusive comparison between human and chimp genomes has been done, the Darwinist ideology led them to assume that there is very little difference between the two species.

A study in October 2002 revealed that the evolutionist propaganda on this issue—like many others—is completely false. Humans and chimps are not "99% similar" as the evolutionist fairy tale went on. Genetic similarity turns out to be less than 95 %. In a news story reported by CNN.com, entitled "Humans, chimps more different than thought," it reads:



> There are more differences between a chimpanzee and a human being than once believed, according to a new genetic study.
>
> Biologists have long held that the genes of





chimps and humans are about 98.5 percent identical. But Roy Britten, a biologist at the California Institute of Technology, said in a study published this week that a new way of comparing the genes shows that the human and chimp genetic similarity is only about 95 percent.

Britten based this on a computer program that compared 780,000 of the 3 billion base pairs in the human DNA helix with those of the chimp. He found more mismatches than earlier researchers had, and concluded that at least 3.9 percent of the DNA bases were different.

This led him to conclude that there is a fundamental genetic difference between the species of about 5 percent.[25]

New Scientist, a leading science magazine and a strong supporter of Darwinism, reported the following on the same subject in an article titled "Human-chimp DNA difference trebled":

> We are more unique than previously thought, according to new comparisons of human and chimpanzee DNA. It has long been held that we share 98.5 per cent of



> our genetic material with our closest relatives. That now appears to be wrong. In fact, we share less than 95 per cent of our genetic material, a three-fold increase in the variation between us and chimps.[26]

Biologist Boy Britten and other evolutionists continue to assess the result in terms of the evolutionary theory, but in fact there is no scientific reason to do so. The theory of evolution is supported neither by the fossil record nor by genetic or biochemical data. On the contrary, evidence shows that different life forms on Earth appeared quite abruptly without any evolutionary ancestors and that their complex systems prove the existence of an "intelligent design."

Human DNA is also similar to that of the worm, mosquito, and chicken!

Moreover, the above-mentioned basic proteins are common vital molecules present, not just in chimpanzees, but also in very many completely different living creatures. The structure of the proteins in all these species is very similar to that of the proteins present in humans.

For example, the genetic analyses published in *New Scientist* have revealed a **75% similarity between the DNA of nematode worms and man**.[27] This definitely does not mean that there is only a 25% difference between man and these worms!

On the other hand, in another finding which also appeared in the media, it was stated that the comparisons carried out between **the genes of fruit flies belonging to the *Drosophila* genus and human genes yielded a similarity of 60%.**[28]

When living things other than man are studied, it appears that there is no molecular relationship such as that claimed by evolutionists.[29] This fact shows that the concept of similarity is not evidence for evolution.

"Common design": The reason for similarities

It is surely natural for the human body to bear some molecular similarities to other living beings, because they all are made up of the same molecules, they all use the same water and atmosphere, and they all consume foods consisting of the same molecules. Certainly, their metabolisms, and therefore their genetic make-ups,

would resemble one another. **This, however, is not evidence that they evolved from a common ancestor.**

This "common material" is the result not of evolution but of "common design," that is, of their being created upon the same plan.

It is possible to explain this matter with an example: all construction in the world is done with similar materials (brick, iron, cement, etc.). This, however, does not mean that these buildings "evolved" from each other. They are constructed separately by using common materials. The same holds for living beings as well.

However, the complexity of the structure of living things cannot be compared to that of bridges, of course.

Life did not originate as the result of unconscious coincidences as evolution claims, but as the result of the creation of God, the Almighty, the possessor of infinite knowledge and wisdom.



WHY IS THE CLAIM THAT DINOSAURS EVOLVED INTO BIRDS AN UNSCIENTIFIC MYTH?

THE theory of evolution is a fairy tale built on the hope of the impossible coming true. Birds have a special place in this story. Above all things, birds possess that magnificent organ, the wing. Beyond the structural wonders of wings, their function also inspires amazement. So much so that flight was man's obsession for thousands of years, and thousands of scientists and researchers put considerable effort into duplicating it. Apart from a few very primitive attempts, man only managed to build machines capable of flying in the twentieth century. Birds have been doing something which man tried to do with the accumulated technology of hundreds of years right through the millions of years that they have existed. Moreover, a young bird can acquire this skill after

only a few attempts. Many of their characteristics are so perfect that not even the products of the latest modern technology can compare with them.

The theory of evolution relies on prejudiced comments and twisting the truth to account for the emergence of life and all its variety. When it comes to living things such as birds, science is finally sidelined completely, to be replaced by evolutionists' fantasy stories. The reason for this is the creatures that evolutionists claim to be the ancestors of birds. The theory of evolution maintains that the ancestors of birds were dinosaurs, members of the reptile family. Such a claim raises two questions that need to be answered. The first is, "How did dinosaurs come to grow wings?" The second is, "Why is there no sign of such a development in the fossil record?"



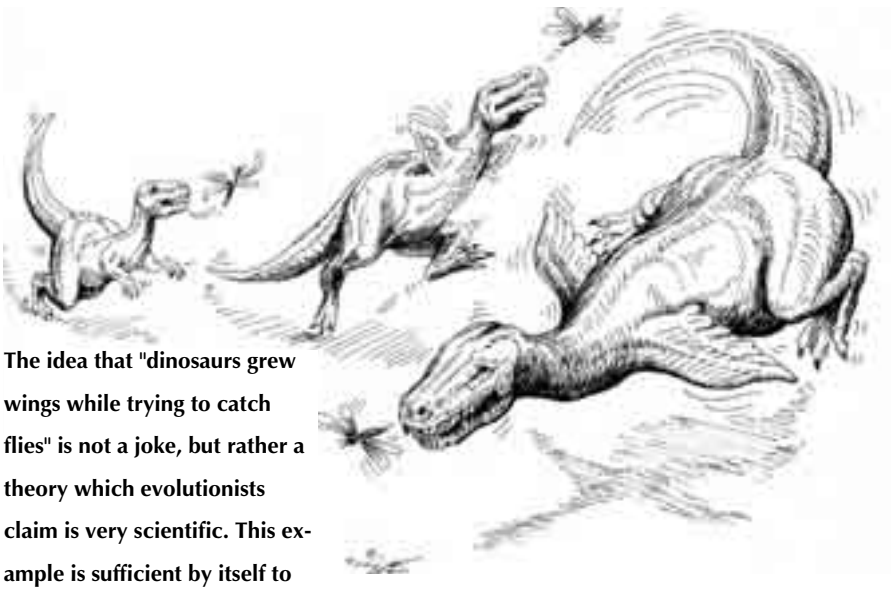
On the subject of how dinosaurs turned into birds, evolutionists debated the matter for a long time and came up with two theories. The first of these is the "cursorial" theory. This maintains that dinosaurs turned into birds by taking to the air from the ground. Supporters of the second theory object to the cursorial theory, and say that it is not possible for dinosaurs to have turned into birds in this way. They offer another solution to the question. They claim that dinosaurs that lived in the branches of trees turned into birds by trying to jump from one branch to another. This is known as the "arboreal" theory. The answer to the question of how dinosaurs could have taken to the air

is also ready: "While trying to catch flies."

However, we must first of all put the following question to those people who claim that a flight system, together with wings, emerged from the body of such an animal as a dinosaur: How did flies' flight system, that is much more efficient than that of a helicopter, which is in turn modelled on them, come about? You will see that evolutionists have no answer. It is certainly most unreasonable for a theory which cannot explain the flight system of such a tiny creature as the fly to claim that dinosaurs turned into birds.

As a result, all reasonable, logical scientists are agreed that the only scientific things about these theories is their Latin names. The essence of the matter is that flight by reptiles is simply the product of fantasy.

Evolutionists who claim that dinosaurs turned into birds



The idea that "dinosaurs grew wings while trying to catch flies" is not a joke, but rather a theory which evolutionists claim is very scientific. This example is sufficient by itself to show how seriously we should take evolutionists.

need to be able to find evidence for it in the fossil record. If dinosaurs did turn into birds, then half-dinosaur, half-bird creatures must have lived in the past and left some trace behind them in the fossil record. For long years evolutionists claimed that a bird called "*Archaeopteryx*" represented such a transition. However, those claims were nothing but a great deception.

The *Archaeopteryx* deception

Archaeopteryx, the so-called ancestor of modern birds according to evolutionists, lived approximately 150 million years ago. The theory holds that some small dinosaurs, such as *Velociraptors* or *Dromaeosaurs*, evolved by acquiring wings and then starting to fly. Thus, *Archaeopteryx* is assumed to be a transitional form that branched off from its dinosaur ancestors and started to fly for the first time.

However, the latest studies of *Archaeopteryx* fossils indicate that this explanation lacks any scientific foundation. This is absolutely not a transitional form, but an extinct species of bird, having some insignificant differences from modern birds.

The thesis that *Archaeopteryx* was a "half-bird" that could not fly perfectly was popular among evolutionist circles until not long ago. The absence of a sternum (breastbone) in this creature was held up as the most important evidence that this bird could not fly properly. (The sternum is a bone found under the thorax to which the muscles required for flight are attached. In our day, this breastbone is observed in all flying and non-flying birds, and even in bats, a flying mammal which belongs to a very different family.)

However, the seventh *Archaeopteryx* fossil, which was found in 1992, disproved this argument. The reason was that in

this recently discovered fossil, the breastbone that was long assumed by evolutionists to be missing was discovered to have existed after all. This fossil was described in the journal *Nature* as follows:

> The recently discovered seventh specimen of the *Archaeopteryx* preserves a partial, rectangular sternum, long suspected but never previously documented. This attests to its strong flight muscles, but its capacity for long flights is questionable. [30]



This discovery invalidated the mainstay of the claims that *Archaeopteryx* was a half-bird that could not fly properly.

Morevoer, the structure of the bird's feathers became one of the most important pieces of evidence confirming that *Archaeopteryx* was a flying bird in the true sense. The asymmetric feather structure of *Archaeopteryx* is indistinguishable from that of modern birds, and indicates that it could fly perfectly well. As the eminent paleontologist Carl O. Dunbar states, "Because of its feathers, [*Archaeopteryx* is] distinctly to be classed as a bird."[31] Paleontologist Robert Carroll further explains the subject:

> The geometry of the flight feathers of *Archaeopteryx* is identical with that of modern flying birds, whereas nonflying

> birds have symmetrical feathers. The way in which the feathers are arranged on the wing also falls within the range of modern birds… According to Van Tyne and Berger, the relative size and shape of the wing of *Archaeopteryx* are similar to that of birds that move through restricted openings in vegetation, such as gallinaceous birds, doves, woodcocks, woodpeckers, and most passerine birds… The flight feathers have been in stasis for at least 150 million years… [32]

Another fact that was revealed by the structure of *Archaeopteryx's* feathers was its warm-blooded metabolism. As was discussed above, reptiles and—although there is some evolutionist wishful thinking on the opposite direction—dinosaurs are cold-blooded animals whose body heat fluctuates with the temperature of their environment, rather than being homeostatically regulated. A very important function of the feathers on birds is the maintenance of a constant body temperature. The fact that *Archaeopteryx* had feathers shows that it was a real, warm-blooded bird that needed to retain its body heat, in contrast to dinosaurs.

The anatomy of *Archaeopteryx* and the evolutionists' error

Two important points evolutionary biologists rely on when claiming *Archaeopteryx* was a transitional form, are the claws on its wings and its teeth.

It is true that *Archaeopteryx* had claws on its wings and teeth in its mouth, but these traits do not imply that the creature bore any kind of relationship to reptiles. Besides, two bird species living today, the *touraco* and the *hoatzin*, have claws which allow them to hold onto branches. These creatures are



Studies of *Archaeopteryx*'s anatomy revealed that it possessed complete powers of flight, just like a modern bird has. The efforts to liken it to a reptile are totally unfounded.

fully birds, with no reptilian characteristics. That is why it is completely groundless to assert that *Archaeopteryx* is a transitional form just because of the claws on its wings.

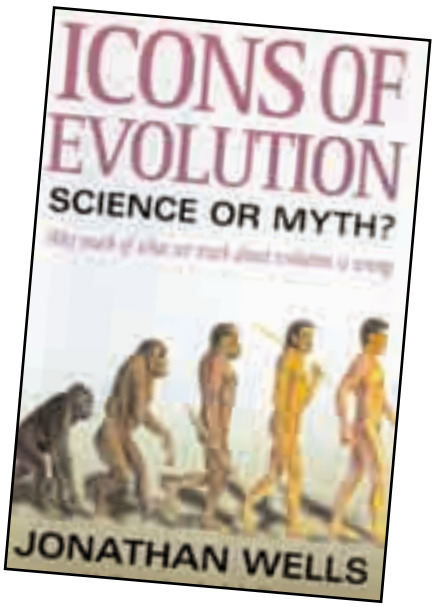
Neither do the teeth in *Archaeopteryx's* beak imply that it is a transitional form. Evolutionists are wrong to say that these teeth are reptilian characteristics, since teeth are not a typical feature of reptiles. Today, some reptiles have teeth while others

do not. Moreover, *Archaeopteryx* is not the only bird species to possess teeth. It is true that there are no toothed birds in existence today, but when we look at the fossil record, we see that both during the time of *Archaeopteryx* and afterwards, and even until fairly recently, a distinct group of birds existed that could be categorised as "birds with teeth."

The most important point is that the tooth structure of *Archaeopteryx* and other birds with teeth is totally different from that of their alleged ancestors, the dinosaurs. The well-known ornithologists L. D. Martin, J. D. Stewart, and K. N. Whetstone observed that *Archaeopteryx* and other similar birds have unserrated teeth with constricted bases and expanded roots. Yet the teeth of theropod dinosaurs, the alleged ancestors of these birds, had serrated teeth with straight roots.[33] These researchers also compared the ankle bones of *Archaeopteryx* with those of their alleged ancestors, the dinosaurs, and observed no similarity between them. [34]

Studies by anatomists such as S. Tarsitano, M.K. Hecht, and A.D. Walker have revealed that some of the similarities that John Ostrom, a leading authority on the subject who claims that *Archaeopteryx* evolved from dinosaurs, and others have seen between the limbs of *Archaeopteryx* and dinosaurs were in reality misinterpretations.[35] For example, A.D. Walker has analysed the ear region of *Archaeopteryx* and found that it is very similar to that of modern birds. [36]

In his book *Icons of Evolution*, American biologist Jonathan Wells remarks that *Archaeopteryx* has been turned into an "icon" of the theory of evolution, whereas evidence clearly shows that this creature is not the primitive ancestor of birds. According to



Wells, one of the indications of this is that theropod dinosaurs—the alleged ancestors of *Archaeopteryx*—are actually younger than *Archaeopteryx*: "Two-legged reptiles that ran along the ground, and had other features one might expect in an ancestor of *Archaeopteryx*, appear later." [37]

All these findings indicate that *Archaeopteryx* was not a transitional link but only a bird that fell into a category that can be called "toothed birds." Linking this creature to theropod dinosaurs is completely invalid. In an article headed "*The Demise of the 'Birds Are Dinosaurs' Theory*," the American biologist Richard L. Deem writes the following about *Archaeopteryx* and the bird-dinosaur evolution claim:

> The results of the recent studies show that the hands of the theropod dinosaurs are derived from digits I, II, and III, whereas the wings of birds, although they look alike in terms of structure, are derived from digits II, III, and IV... There are other problems with the "birds are dinosaurs" theory. The theropod forelimb is much smaller (relative to body size) than that of *Archaeopteryx*. The small "proto-wing" of the theropod is not very convincing, especially considering the rather hefty weight of these dinosaurs. The vast majority of the theropod lack the semilunate wrist bone, and have a

> large number of other wrist elements which have no homology to the bones of *Archaeopteryx*. In addition, in almost all theropods, nerve V1 exits the braincase out the side, along with several other nerves, whereas in birds, it exits out the front of the braincase, though its own hole. There is also the minor problem that the vast majority of the theropods appeared after the appearance of *Archaeopteryx*. [38]

These facts once more indicate for certain that neither *Archaeopteryx* nor other ancient birds similar to it were transitional forms. The fossils do not indicate that different bird species evolved from each other. On the contrary, the fossil record proves that today's modern birds and some archaic birds such as *Archaeopteryx* actually lived together at the same time. It is true that some of these bird species, such as *Archaeopteryx* and *Confuciusornis*, have become extinct, but the fact that only some of the species that once existed have been able to survive down to the present day does not in itself support the theory of evolution.

Latest Evidence: Ostrich Study Refutes The Dino-Bird Story

The latest blow to the "birds evolved from dinosaurs" theory came from a study made on the embryology of ostriches.

Drs. Alan Feduccia and Julie Nowicki of the University of North Carolina at Chapel Hill studied a series of live ostrich eggs and, once again, concluded that, there cannot be an evolutionary link between birds and dinosaurs. EurekAlert, a scientific portal held by the American Association for the The Advancement of Science (AAAS), reports the following:

> Drs. Alan Feduccia and Julie Nowicki of the University of



Dr. Alan Feduccia

> North Carolina at Chapel Hill... opened a series of live ostrich eggs at various stages of development and found what they believe is proof that birds could not have descended from dinosaurs...
>
> Whatever the ancestor of birds was, it must have had five fingers, not the three-fingered hand of theropod dinosaurs," Feduccia said... "Scientists agree that dinosaurs developed 'hands' with digits one, two and three... Our studies of ostrich embryos, however, showed conclusively that in birds, only digits two, three and four, which correspond to the human index, middle and ring fingers, develop, and we have pictures to prove it," said Feduccia, professor and former chair of biology at UNC. "This creates a new problem for those who insist that dinosaurs were ancestors of modern birds. How can a bird hand, for example, with digits two, three and four evolve from a dinosaur hand that has only digits one, two and three? That would be almost impossible."[39]

In the same report, Dr. Feduccia also made important comments on the invalidity—and the shallowness—of the "birds evolved from dinosaurs" theory:

> "There are insurmountable problems with that theory," he [Dr. Feduccia] said. "Beyond what we have just reported, there is the time problem in that superficially bird-like dinosaurs occurred some 25 million to 80 million years after the earliest known bird, which is 150 million years old."
>
> "If one views a chicken skeleton and a dinosaur skeleton through binoculars they appear similar, but close and de-

tailed examination reveals many differences," Feduccia said. "Theropod dinosaurs, for example, had curved, serrated teeth, but the earliest birds had straight, unserrated peg-like teeth. They also had a different method of tooth implantation and replacement."[40]

This evidence once again reveals that the "dino-bird" hype is just another "icon" of Darwinism: a myth that is supported only for the sake of a dogmatic faith in the theory.

Evolutionists' bogus dino-bird fossils

With the collapse of evolutionists' claims regarding fossils like *Archaeopteryx*, they are now at a complete dead-end as regards the origin of birds. That is why some evolutionists have had to resort to classical methods–forgery. In the 1990s, the public were several times given the message that "a half-dinosaur, half-bird fossil has been found." The evolutionist media carried pictures of these so-called "dino-birds" and an international campaign was thus set in motion. However, it soon began to emerge that the campaign was based on contradiction and forgery.



A *Sinosauropteryx* fossil.

The first hero of the campaign was a dinosaur called *Sinosauropteryx*, discovered in China in 1996. The fossil was presented to the whole world as a "feathered dinosaur," and made a number of headlines. However, detailed analyses in the months

that followed revealed that the structures which evolutionists had excitedly portrayed as "bird feathers" were actually nothing of the kind.

This was how the matter was presented in an article called "Plucking the Feathered Dinosaur" in the journal *Science*:

> Exactly 1 year ago, paleontologists were abuzz about photos of a so-called "feathered dinosaur," which were passed around the halls at the annual meeting of the Society of Vertebrate Paleontology. The *Sinosauropteryx* specimen from the Yixian Formation in China made the front page of *The New York Times*, and **was viewed by some as confirming the dinosaurian origins of birds. But at this year's vertebrate paleontology meeting in Chicago late last month, the verdict was a bit different:** The structures are not modern feathers, say the roughly half-dozen Western paleontologists who have seen the specimens…paleontologist Larry Martin of Kansas University, Lawrence, thinks the structures are frayed collagenous fibers beneath the skin—-and so **have nothing to do with birds.**[41]

Another "dino-bird" storm blew up in 1999. Another fossil discovered in China was presented to the world as "major evidence for evolution." *National Geographic* magazine, the source of the campaign, drew and published imaginary "feathered dinosaur" pictures inspired by the fossil, and these hit the headlines in a number of countries. This species, which was said to have lived 125 million years ago, was immediately given the scientific name *Archaeoraptor liaoningensis.*

However, the fossil was a fake and was skilfully constructed from five separate specimens. A group of researchers, among whom were also three paleontologists, proved the

forgery one year later with the help of X-ray computed tomography. The dino-bird was actually the product of a Chinese evolutionist. Chinese amateurs formed the dino-bird by using glue and cement from 88 bones and stones. Research suggests that *Archaeoraptor* was built from the front part of the skeleton of an ancient bird, and that its body and tail included bones from four different specimens. An article in the scientific journal *Nature* describes the forgery like this:

> The *Archaeoraptor* fossil was announced as a 'missing link' and purported to be possibly the best evidence since *Archaeopteryx* that birds did, in fact, evolve from certain types of carnivorous dinosaur. But *Archaeoraptor* was revealed to be a forgery in which bones of a primitive bird and a non-flying dromaeosaurid dinosaur had been combined… The *Archaeoraptor* specimen, which was reportedly collected from the Early Cretaceous Jiufotang Formation of Liaoning, was smuggled out of China and later sold in the United States on the commercial market… We conclude that *Archaeoraptor* represents two or more species and that it was assembled from at least two, and possibly five, separate specimens.... [42]

So how was it that *National Geographic* could have presented such a huge scientific forgery to the whole world as "major evidence for evolution"? The answer to this question lay concealed in the magazine's evolutionary fantasies. Since *National Geographic* was blindly supportive of Darwinism and had no hesitation about using any propaganda tool it saw as being in favour of the theory, it ended up signing up to a second "Piltdown man scandal."

Evolutionist scientists also accepted *National Geographic*'s

fanaticism. Dr. Storrs L. Olson, head of the famous U.S. Smithsonian Institute's Ornithology Department, announced that he had previously warned that the fossil was a forgery, but that the magazine's executives had ignored him. In a letter he wrote to Peter Raven of *National Geographic*, Olson wrote:

> Prior to the publication of the article "Dinosaurs Take Wing" in the July 1998 *National Geographic*, Lou Mazzatenta, the photographer for Sloan's article, invited me to the National Geographic Society to review his photographs of Chinese fossils and to comment on the slant being given to the story. At that time, I tried to interject the fact that strongly supported alternative viewpoints existed to what *National Geographic* intended to present, but it eventually became clear to me that *National Geographic* was not interested in anything other than the prevailing dogma that birds evolved from dinosaurs.[43]

In a statement in *USA Today*, Olson said, "**The problem is, at some point the fossil was known by *Geographic* to be a fake, and that information was not revealed**."[44] In other words, he said that *National Geographic* maintained the deception, even though it knew that the fossil it was portraying as proof of evolution was a forgery.

We must make it clear that this attitude of *National Geographic* was not the first forgery that had been carried out in the name of the theory of evolution. Many such incidents have taken place since it was first proposed. The German biologist Ernst Haeckel drew false pictures of embryos in order to support Darwin. British evolutionists mounted an orangutan jaw on a human skull and exhibited it for some 40 years in the British Museum as "Piltdown man, the greatest evidence for

THE DINOSAUR DECEPTION IN THE EVOLUTIONIST MEDIA...



Natural Geographic, November 1999



Natural Geographic, November 1999

AND THE TRUTH UNVEILED



The *Archaeoraptor* forgery

The *Archaeoraptor* fossil was announced as a 'missing link' and purported to be possibly the best evidence since *Archaeopteryx* that birds did, in fact, evolve between birds and extinct non-avian dinosaurs[2]. But *Archaeoraptor* was revealed to be a forgery in which bones of a primitive bird and a non-flying dromaeosaurid dinosaur had been combined[3]. Here we use high-resolution X-ray computed tomography (CT) to determine the nature and extent of the forgery, as well as how it was built, by imaging the fracture pattern

Nature, March, 29, 2001



National Geographic **magazine portrayed "dino-birds" in this way in 1999, and presented them to the whole world as evidence of evolution. Two years later, however, the source of inspiration for these drawings, *Archaeoraptor*, was shown to be a scientific falsehood.**



Even if evolutionists are unsuccessful in finding scientific evidence to support their theories, they are very successful at one thing: propaganda. The most important element of this propaganda is the practice of creating false designs known as "reconstructions." With brushes in their hands, evolutionists produce imaginary creatures; nevertheless, the fact that these drawings correspond to no matching fossils constitutes a serious problem for them.

evolution." American evolutionists put forward "Nebraska man" from a single pig's tooth. All over the world, false pictures called "reconstructions," which have never actually lived, have been portrayed as "primitive creatures" or "ape-men."

In short, evolutionists once again employed the method they first tried in the Piltdown man forgery. They themselves created the intermediate form they were unable to find. This event went down in history as showing how deceptive the international propaganda on behalf of the theory of evolution is, and that evolutionists will resort to all kinds of falsehood for its sake.



WHAT SCIENTIFIC FORGERY IS THE MYTH THAT "HUMAN EMBRYOS HAVE GILLS" BASED ON?

THE thesis that living things go through various stages in their mothers' wombs that can be seen as evidence for evolution has a special position amongst the unfounded claims of the theory of evolution. That is because the thesis, known as "recapitulation" in evolutionist literature, is more than a scientific deception: It is a scientific forgery.

Haeckel's recapitulation superstition

The term "recapitulation" is a condensation of the dictum "ontogeny recapitulates phylogeny," put forward by the evolutionary biologist Ernst Haeckel at the end of the nineteenth century. This theory of Haeckel's postulates that living embryos



Ernst Haeckel, one of the foremost charlatans in the history of science.

re-experience the evolutionary process that their pseudo-ancestors underwent. He theorised that during its development in its mother's womb, the human embryo first displays the characteristics of a fish, then those of a reptile, and finally those of a human. The claim that the embryo possesses "gills" while it develops stems from this thesis.

However, this is utter superstition. Scientific developments in the years since recapitulation was first broached have enabled studies to be made of just how valid it is. These studies have shown that the recapitulation doctrine has no other basis than evolutionists' imaginations and deliberate distortions.

It is now known that the "gills" that supposedly appear in the early stages of the human embryo are in fact the initial

phases of the middle-ear canal, parathyroid, and thymus. That part of the embryo that was likened to the "egg yolk pouch" turns out to be a pouch that produces blood for the infant. The part that was identified as a "tail" by Haeckel and his followers is in fact the backbone, which resembles a tail only because it takes shape before the legs do.

These are universally acknowledged facts in the scientific world, and are accepted even by evolutionists themselves. George Gaylord Simpson, one of the founders of neo-Darwinism, writes:

> Haeckel misstated the evolutionary principle involved. It is now firmly established that ontogeny does not repeat phylogeny.[45]

The following was written in an article in *New Scientist* dated October 16, 1999:

> [Haeckel] called this the biogenetic law, and the idea became popularly known as recapitulation. In fact Haeckel's strict law was soon shown to be incorrect. For instance, **the early human embryo never has functioning gills like a fish, and never passes through stages that look like an adult reptile or monkey**. [46]

In an article published in *American Scientist*, we read:

> Surely the biogenetic law is as dead as a doornail. It was finally exorcised from biology textbooks in the fifties. As a topic of serious theoretical inquiry it was extinct in the twenties… [47]

As we have seen, developments since it was first put forward have shown that recapitulation has no scientific basis at all.

However, those same advances would show that it was not just a scientific deception, but that it stemmed from a complete "forgery."

Haeckel's forged drawings

Ernst Haeckel, who first put the recapitulation thesis forward, published a number of drawings to back up his theory. **Haeckel produced falsified drawings to make fish and human embryos resemble each other!** When he was caught out, the only defense he offered was that other evolutionists had committed similar offences:

> After this compromising confession of "forgery" I should be obliged to consider myself condemned and annihilated if I had not the consolation of seeing side by side with me in the prisoner's dock hundreds of fellow-culprits, among them many of the most trusted observers and most esteemed biologists. The great majority of all the diagrams in the best biological textbooks, treatises and journals would incur in the same degree the charge of "forgery," for all of them are inexact, and are more or less doctored, schematised and constructed. [48]

In the September 5, 1997, edition of the well-known scientific journal *Science*, an article was published revealing that Haeckel's embryo drawings were the product of a deception. The article, called **"Haeckel's Embryos: Fraud Rediscovered,"** had this to say:

> The impression they [Haeckel's drawings] give, that the embryos are exactly alike, is wrong, says Michael Richardson, an embryologist at St. George's Hospital Medical School in London… So he and his colleagues did their own comparative study, reexamining and photographing embryos

roughly matched by species and age with those Haeckel drew. Lo and behold, the embryos "often looked surprisingly different," Richardson reports in the August issue of *Anatomy and Embryology*.[49]

Later in this same article, the following information was revealed:

> Not only did Haeckel add or omit features, Richardson and his colleagues report, but **he also fudged the scale to exaggerate similarities among species, even when there were 10-fold differences in size.** Haeckel further blurred differences by neglecting to name the species in most cases, as if one representative was accurate for an entire group of animals. In reality, Richardson and his colleagues note, even closely related embryos such as those of fish vary quite a bit in their appearance and developmental pathway. "It [Haeckel's drawings] looks like it's turning out to be **one of the most famous fakes in biology**," Richardson concludes.[50]



Science,
September 5, 1997

RESEARCH NEWS

Haeckel's Embryos: Fraud Rediscovered


Evolutionists Battle New Theory on Creation

Biology Text Illustrations More Fiction Than Fact

In its April 8, 2001, edition, *The New York Times* devoted wide space to the theory of intelligent design and the ideas of scientists and philosophers who support the theory, such as Michael Behe and William Dembski. In general, it said that the theory of intelligent design possessed such a scientific respectability and validity that it would rock Darwinism to its foundations. The paper also compared Haeckel's forged drawings with true pictures of embryos taken under the microscope.

It is noteworthy that, although Haeckel's falsification came out in 1901, the subject was still portrayed in many evolutionist publications for nearly a century as if it were a proven scientific law. Those who held evolutionist beliefs inadvertently sent out a most important message by putting their ideology before science: Evolution is not science, it is a dogma that they are trying to keep alive in the face of the scientific facts.



WHY IS IT DECEPTIVE TO PORTRAY CLONING AS "EVIDENCE FOR EVOLUTION"?

THE fact that such a question as whether such a scientific advance as cloning "supports evolution" is asked or even comes to mind actually reveals a very important truth. This is the cheapness of the propaganda that evolutionists resort to to get people to accept their theory. Since the subject of cloning has nothing to do with the theory of evolution, it cannot be a matter of concern for any professional evolutionist. However, some of those who blindly support evolution at whatever cost, and particularly certain circles within media organizations, have even tried to turn such a totally unconnected matter as cloning into propaganda for evolution.



Cloning is the using of one life form's DNA code to make a copy of that life form in the laboratory. It is a biological process, and has nothing to do with evolution. There is no question of the emergence of a new species or organ, nor indeed of any development or change.

What does cloning a living thing mean?

The DNA of the living thing that is proposed to be copied is used in the cloning process. The DNA is extracted from any cell belonging to the organism in question, and then placed into an egg cell belonging to another organism of the same species. A shock is then given immediately afterwards, which prompts the egg cell to start dividing. The embryo is then placed into a living thing's womb, where it continues to divide. Scientists then await its development and birth.

Why has cloning nothing to do with evolution?

The concepts of cloning and evolution are completely different. The theory of evolution is built on the claim that inanimate matter turned into living matter by chance. (There is not the slightest scientific proof that this could actually happen.) Cloning, on the other hand, is the copying of a living thing by using genetic material from that creature's cells. The new organism starts from a single cell, and a biological process is transferred to the laboratory and repeated there. In other words, there is no question of such a process happening by "chance"—the basic claim of the theory of evolution—nor of "lifeless matter coming to life."

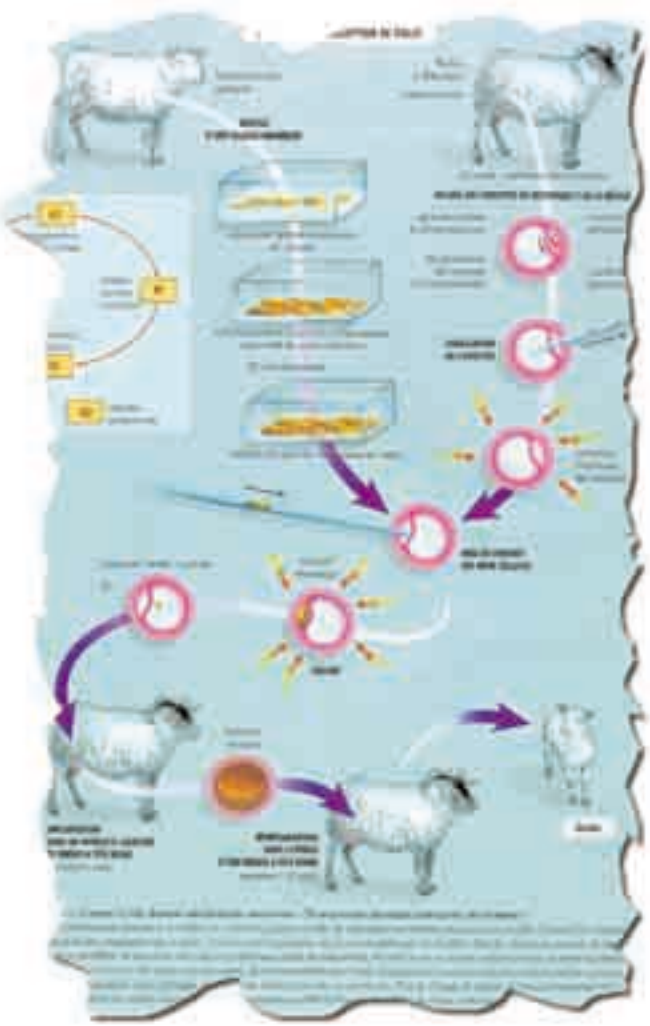


Copying consists of adding already existing genetic information to the already existing reproductive mechanism of a living thing. No new mechanism or genetic information is created by the process.

The cloning process is no evidence for evolution whatsoever. It is, however, clear evidence of a biological law that totally undermines evolution. That is the famous principle that "Life can only come from life," put forward by the famous scientist Louis Pasteur towards the end of the nineteenth century. The fact that cloning is presented as evidence for evolution, despite that open truth, is a deception being carried out by the media.

Advances in many branches of science over the last 30 years have demonstrated that the emergence of life cannot be explained in terms of chance. Evolutionists' scientific errors and one-sided comments have been well-documented, and the theory of evolution has become indefensible within the realm of science. This fact has propelled some evolutionists to look in other areas. That is why scientific advances such as "cloning," or "test-tube babies," have been so fanatically used as evidence for evolution in the recent past.

Evolutionists have nothing more to say to society in the name of science, and so take refuge in the gaps in people's scientific knowledge and try to prolong the theory's life in that way, even though that merely brings the theory to a pitiable



Cloning has recently become a matter of major concern to scientists.
Although it is a biological process carried out within the framework of known laws, evolutionists have tried to take it over in the excited hope that it might support their theory, as happens with every new scientific discovery. The media that gives ideological backing to evolution made headlines out of it, accompanied by slogans supporting evolution. Although it has absolutely no scientific foundation, Darwinists attempted to use cloning as evidence for evolution in various debates. Yet it was clear that cloning had nothing to do with evolution. The scientific community did not even take these ridiculous efforts seriously. Right: A diagram of how cloning works, taken from a scientific publication.

state. Just like all other scientific advances, cloning is a very important and revealing scientific advance that also sheds light on the fact that life was created.

Other misinterpretations of cloning

Another misunderstanding that people have fallen into as regards cloning is the idea that cloning can "create human beings." However, cloning bears no such interpretation. Cloning

consists of adding genetic information which already exists to a living reproduction mechanism that also already exists. No new mechanism or genetic information is created in the process. Genetic information is taken from someone who already exists and is placed inside a female womb. This enables the child that is eventually born to be the "identical twin" of the person from whom the genetic information was taken.

Many people who do not fully understand what cloning is have all kinds of fantastic ideas about it. For instance, they imagine that a cell can be taken from a 30-year-old man and another 30-year-old can be created that same day. Such an example of cloning is only to be found in science fiction, and is not and never will be possible. Cloning basically consists of bringing a person's "identical twin" to life by natural methods (in other words in a mother's womb).This has nothing to do with the theory of evolution, nor with the concept of "creating man."

Creating a human being or any other living thing—in other words bringing something into existence out of nothing—is a power peculiar to God. Scientific advances confirm the same thing by showing that this creation cannot be done by man. This is expressed in a verse:

> **The Originator of the heavens and Earth. When He decides on something, He just says to it, "Be!" and it is. (Qur'an, 2: 117)**



COULD LIFE HAVE COME FROM OUTER SPACE?

WHEN Darwin put forward his theory in the middle of the nineteenth century, he never mentioned how the origin of life, in other words the first living cell, came to be. Scientists looking for the origin of life at the beginning of the twentieth century began to realise that the theory was invalid. The complex and perfect structure in life prepared the ground for many researchers to perceive the truth of creation. Mathematical calculations and scientific experiment and observation demonstrated that life could not be the "product of chance," as the theory of evolution claimed.

With the collapse of the claim that coincidence was responsible and the realisation that life was "planned," some scientists began to look for the origin of life in outer space. The

best-known of the scientists who made such claims were Fred Hoyle and Chandra Wickramasinghe. These two cobbled together a scenario in which they proposed that there was a force which "seeded" life in space. According to the scenario, these seeds were carried through the emptiness of space by gas or dust clouds, or else by an asteroid, and eventually reached the Earth, and life thus started here.

Nobel Prize–winner Francis Crick, co-discoverer with James Watson of the double helix structure of DNA, is one of those who has sought the origin of life in outer space. Crick came to realise that it is quite unreasonable to expect life to have started by chance, but he has claimed instead that life on Earth was started by intelligent "extraterrestrial" powers.

As we have seen, the idea that life came from outer space has influenced prominent scientists. The matter is now even discussed in writings and debates on the origin of life. The idea of looking for the origin of life in outer space can be considered from two basic perspectives.

Scientific inconsistency

The key to evaluating the "life began in outer space" thesis lies in studying the meteorites that reached the Earth and the clouds of gas and dust existing in space. No evidence has yet been found to support the claim that celestial bodies contained non-earthly creatures that eventually seeded life on Earth. No research that has been carried out so far has revealed any of the complex macromolecules that appear in life forms.

Furthermore, the substances contained in meteorites do not possess a certain kind of asymmetry found in the macro-



It is not possible for meteors to carry a living organism to Earth because of the intense heat generated when they enter the atmosphere and the violence of impact when they land. Above: A large meteor crater in Arizona. Even if we accept there are living things in outer space, it is still impossible to account for their origins in any other way than through creation.

molecules that constitute life. For instance, amino acids, which make up proteins, which are themselves the basic building blocks of life, should theoretically occur as both left- and right-handed forms ("optical isomers") in roughly equal numbers. However, only left-handed amino acids are found in proteins, whereas this asymmetric distribution does not occur among the small organic molecules (the carbon-based molecules found in living things) discovered in meteorites. The latter exist in both left- and right-handed forms.[51]

That is by no means the end of the obstacles to the thesis that bodies and substances in outer space gave rise to life on Earth. Those who maintain such an idea need to be able to explain why such a process is not happening now, because the Earth is still being bombarded by meteorites. However, study

of these meteorites has not revealed any "seeding" to confirm the thesis in any way.

Another question confronting the defenders of the thesis is this: Even if it is accepted that life was formed by a consciousness in outer space, and that it somehow reached Earth, how did the millions of species on Earth come about? That is a huge dilemma for those who suggest that life began in space.

Alongside all of these obstacles, no trace has been found in the universe of a civilisation or life form that could have started life on Earth. No astronomical observations, which have picked up enormous speed in the last 30 years, have given any indication of the presence of such a civilisation.

What lies behind the "extraterrestrial" thesis?

As we have seen, the theory that life on Earth was begun by extraterrestrials has no scientific basis to it. No discoveries have been made to confirm or support it. However, when the scientists who put forward the suggestion began to look in that direction, they did so because they perceived one important truth.

The truth in question is that a theory that seeks to explain life on Earth as being the result of chance is no longer tenable. It has been realised that the complexity revealed in the life forms on Earth can only be the product of intelligent design. In fact, the areas of expertise of the scientists who sought the origin of life in outer space give a clue as to their rejection of the logic of the theory of evolution.

Both are world-renowned scientists: Fred Hoyle is an astronomer and bio-mathematician, and Francis Crick a molecular biologist.



EVOLUTIONISTS' "EXTRATERRESTRIAL" DILEMMA

Claims that the origin of life could lie in space, or even "extraterrestrials," are nothing more than science fiction. No concrete evidence can be supplied to back them up, and news and comments on the subject just consist of speculation that "it could have happened." In fact, these scenarios are quite impossible. Even if we assume that some organic compounds were carried to Earth by meteors, it is a chemical, physical, and mathematical fact that these compounds could not have given rise to life by themselves. The fantasy that life on Earth could have been created by "extraterrestrials" is a ploy by means of which evolutionists try to avoid admitting the existence of God, since life cannot be explained by chance. But this is totally meaningless, too, because the "extraterrestrial" thesis just takes the question one step back, and leads to the question: "Who created the extraterrestrials?" Reason and science lead us to an Absolute Being who created us and all living things, though He Himself was not created and has existed forever. That means God, the Creator of everything.

THE SUPERSTITION EVOLUTIONISTS SO BLINDLY BELIEVE IN:

Inanimate matter + Time = Millions of complex living species

The above formula is the shortest way of expressing the theory of evolution. Evolutionists believe that inanimate and unconscious collections of atoms and molecules came together and organised themselves over time, finally becoming alive and turning into millions of exceedingly complex and perfect living species. This superstition is backed up by no known physical or chemical law. On the contrary, the laws of physics and chemistry show that time has a "disorganising, destructive" effect, not an "organising" one (the Second Law of Thermodynamics). Actually, the "time" factor is nothing but a deception used by evolutionists to take their theory out of the field of observation. Since no "evolutionary process" which creates new living things can be observed in nature, evolutionists try to gloss over this fact by saying: "Yes, evolution cannot be observed, but it may have taken place over the previous millions of years." This claim is also torn down by the fossil record, which shows that no evolutionary process ever happened.

One point which needs to be considered is that those scientists who look to outer space to find the origin of life do not actually make any new interpretation of the matter. Scientists such as Hoyle, Wickramasinghe, and Crick began to consider the possibility that life came from space because they realised that life could not have come about by chance. Since it was impossible for life on Earth to have begun by chance, they had to accept the existence of a source of intelligent design in outer space.

However, the theory put forward by them on the subject of the origin of this intelligent design is contradictory and meaningless. Modern physics and astronomy have revealed that our universe originated as a result of a huge explosion

some 12-15 billion years ago known as "The Big Bang." All matter in the universe came about from that explosion. For this reason, any idea that seeks the origin of life on Earth in another matterbased life form in the universe has to explain in turn how that form of life came into existence. The meaning of this is that such a suggestion does not actually solve the problem, but takes it one step further back. (For more detail, see Harun Yahya's books *The Creation of the Universe* and *Timelessness and The Reality of Fate*).

As we have seen, the thesis that "life came from outer space" does not support evolution, but is a view that reveals the impossibility of evolution and accepts that there can be no other explanation for life than intelligent design. The scientists who suggested this began with a correct analysis but then went down a false road, and started the silly search for the origin of life in outer space.

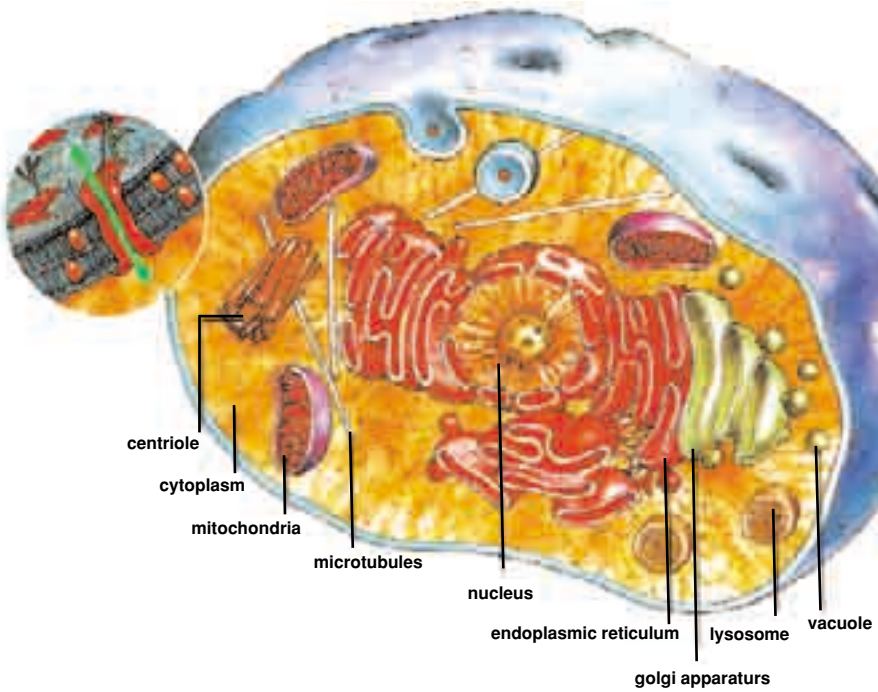
It is obvious that the concept of "extraterrestrials" cannot account for the origin of life. Even if we accept for one moment the hypothesis that "extraterrestrials" actually exist, it is still clear that they could not have come into being by chance, but must themselves be the product of intelligent design. (That is because the laws of physics and chemistry are the same everywhere in the universe, and they make it impossible for life to emerge by chance.) This shows that God, Who is beyond matter and time, and possesses infinite might, wisdom, and knowledge, created the universe and everything in it.



WHY DOES THE FACT THAT THE EARTH IS FOUR BILLION YEARS OLD NOT SUPPORT THE THEORY OF EVOLUTION?

EVOLUTIONISTS base their scenarios on natural effects and chance. One of the concepts they most shelter behind while doing so is that of "considerable time." For instance, the German scientist Ernst Haeckel, who supported Darwin, claimed that a living cell could originate from simple mud. With the realisation in the twentieth century of how complex the living cell actually is, the silliness of that claim became apparent, but evolutionists continued to mask the truth with the "considerable time" concept.

By doing this, they are trying to free themselves from the problem by plunging it into a quandary instead of answering the question of how life could have come about by chance. By giving the impression that the passage of a long period of time



There are serious doubts concerning evolutionists' reason and judgement, as they believe that the living cell, which cannot be synthesised in the most modern laboratories with the most sophisticated technology, could have come about in primitive and uncontrolled natural conditions.

could be useful from the point of view of the emergence of life and increase in variety, they present time as something that is always beneficial. For example, the Turkish evolutionist Professor Yaman Örs says: "If you want to test the theory of evolution, place an appropriate mixture into water, wait a few million years, and you will see that some cells emerge."[52]

This claim is utterly illogical. There is no evidence to suggest that such a thing could happen. The idea that animate matter could emerge from inanimate is actually a superstition dating back to the Middle Ages. At that time, people assumed that the sudden appearance of some living things was the result of "spontaneous generation." According to this belief, people considered that geese emerged from trees, lambs from water-

melons, and even tadpoles from patches of water formed in clouds, falling to Earth as rain. In the 1600s, people began to believe that mice could be born in a mixture of wheat and a dirty piece of cloth, and that flies formed when dead flies were mixed with honey.



Louis Pasteur

However, the Italian scientist Francesco Redi, proved that mice did not form in a mixture of wheat and a dirty piece of cloth, nor living flies from a mixture of dead flies and honey. These living things did not originate from those lifeless substances, they merely used them as vehicles. For example, a living fly would deposit its eggs on a dead one, and a short while later a number of new flies would emerge. In other words, life emerged from life, not inanimate matter. In the nineteenth century, French scientist Louis Pasteur proved that germs did not come from inanimate matter, too. This law, that "life only comes from life," is one of the bases of modern biology.

The fact that the peculiar claims we have been discussing above were actually believed may be excused on the grounds of the lack of knowledge of seventeenth century scientists, bearing in mind the conditions at the time. Nowadays, however, at a time when science and technology have progressed so far, and the fact that life cannot emerge from inanimate matter has been demonstrated by experiment and observation, it is really surprising that evolutionists such as Yaman Örs should still be defending such a claim.

Modern scientists have demonstrated many times that it is impossible for that claim to actually happen. They have carried

out controlled experiments in the most advanced laboratories, reproducing the conditions at the time when life first emerged, but these have all been in vain.

When phosphorus, potassium, magnesium, oxygen, iron, and carbon atoms, which are all essential for life, are brought together, all that emerges is a mass of inanimate matter. Evolutionists, however, suggest that a mass of atoms came together and organised themselves, over time, in the ideal proportions, at the appropriate time and place, and with all the necessary links between them. They further claim that as a result of the perfect organization of these inanimate atoms, and the fact that all these processes went ahead undisturbed, there duly emerged human beings capable of seeing, hearing, speaking, feeling, laughing, rejoicing, suffering, feeling pain and joy, laughing, loving, feeling compassion, perceiving musical rhythms, enjoying food, founding civilisations, and carrying out scientific research.

However, it is perfectly clear that even if all the conditions evolutionists insist on are realised, and even if millions of years are allowed to pass, such an experiment will be doomed to failure.

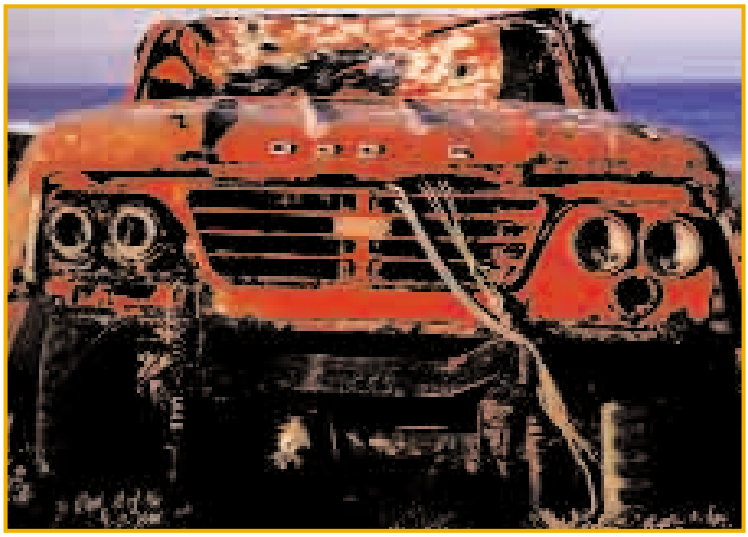
Evolutionists try to conceal this fact, however, with deceptive explanations such as "All things are possible with time." The invalidity of this claim, which is based on introducing an element of bluff into science, is also obvious. This invalidity can be quite clearly seen when the subject is considered from different points of view. In one simple example, let us consider when the passing of time is useful, and when it is harmful. Imagine, if you will, a wooden boat on the seashore, and a captain who at first maintains that boat, repairing, cleaning, and painting it. As long as the captain takes an interest in it, the boat will become ever more attractive, safe, and well-maintained.

Then let us imagine that the boat is left abandoned. This time, the effects of the sun, rain, wind, sand, and storms will cause the boat to decay, age, and eventually become unusable.

The only difference between these two scenarios is that in the former there is an intelligent, knowledgeable, and powerful intervention. The passing of time can only bring benefits with it when it is controlled by an intelligent force. If it is not, time has destructive effects, not constructive ones. In fact, this is a scientific law. The law of entropy, known as the "Second Law of Thermodynamics," states that all systems in the universe tend directly towards disorder, dispersion, and decay when left to themselves and to natural conditions.

This fact demonstrates that the long life of the Earth is a factor that destroys knowledge and order and increases chaos—the exact opposite of what evolutionists claim. The emergence of an ordered system based on knowledge can only be the product of an intelligent intervention.

When the proponents of evolution relate the fairy tale of the transformation of one species into another, they take refuge in the idea of it happening "over a long period of time." In that way, they propose that things somehow happened in the past which have never been confirmed by any experiment or observation. However, everything in the world and in the universe happens in accordance with fixed laws. These do not change over time. For example, things fall to Earth because of the force of gravity. They do not start to fall upwards with the passage of time. Neither will they do so even if trillions of years go by. Lizard offspring are always lizards. That is because the genetic information to be passed on is always that of a lizard, and no supplementary information can be added to it with natural causes. Information may diminish, or even decay, but it is quite impossible for anything to be added to it. That, in turn, is be-



It is not possible for a car left all alone in natural conditions to turn into a more developed model with the passage of time. On the contrary, the bodywork will rust, the paint will fall off, the windows will break, and it will soon turn into a heap of scrap. The same inevitable process occurs even faster in organic molecules and living things.

cause the adding of information to a system requires knowledgeable and intelligent external intervention and control. Nature itself does not possess such properties.

Repetitions that occur over time, and the fact that they take place often, change nothing. Even if trillions of years are allowed to go by, a bird will never hatch out of a lizard's egg. A long lizard may, or a short one—a stronger one or a weaker one—but it will always be a lizard. A different species will never emerge. The concept of "a considerable time" is a deception designed to take the matter out of the realm of experiment and observation. It makes no difference whether 4 billion years go by, or 40, or even 400. That is because there is no natural law or tendency to make the impossibilities described in the theory of evolution actually possible.



WHY ARE WISDOM TEETH NOT EVIDENCE OF EVOLUTION?

ONE of the theory of evolution's important deceptions is its claim regarding "vestigial organs." Evolutionists claim that some organs in living things lose their original function over time, and that such organs then disappear. Taking that as a starting point, they then try to send out the message, "If the living body had really been created, it would have no functionless organs in it."

Evolutionist publications at the start of the twentieth century announced that the human body contained up to a hundred organs that no longer served any purpose, including the appendix, the coccyx, the tonsils, the pineal gland, the external ear, the thymus, and wisdom teeth. However, the decades that followed saw major advances in medical

science. Our knowledge of the organs and systems in the human body increased. As a result of this, it was seen that the idea of vestigial organs was just a superstition. The long list drawn up by evolutionists rapidly shrank. It was discovered that the thymus is an organ which produces important immune system cells, and that the pineal gland is responsible for the production of important hormones. It also emerged that the coccyx supports the bones around the pelvis, and that the external ear plays an important role in identifying where sounds come from. In short, it emerged that ignorance was the only foundation on which the idea of "vestigial organs" rested.

Modern science has many times demonstrated the error of the concept of such organs. Yet some evolutionists still try to make use of this claim. Although medical science has proved that almost all of the organs that evolutionists claim are vestigial actually serve a purpose, evolutionary speculation still surrounds one or two organs.

The most noteworthy of these is our wisdom teeth. The claim that these teeth are a part of the human body that has lost all purpose still appears in evolutionist sources. As evidence for this, it is stated that these teeth give a great many people a lot of trouble, and that chewing is not impaired when they are surgically removed.

Many dentists, influenced by the evolutionists' claim that wisdom teeth serve no purpose, have come to see their extraction as a routine matter, and do not make the same kind of effort to protect them as they do for other teeth.[53] However, research in recent years has shown that wisdom



Wisdom tooth problems stem from the contemporary diet, not because they are vestigial organs.

teeth have the same chewing function as other teeth. Studies have also been carried out to show that the belief that wisdom teeth damage the position of other teeth in the mouth is completely unfounded.[54] Scientific criticism is now amassing ways in which problems with wisdom teeth which could be solved in other ways are instead solved by extracting them.[55] In fact, the scientific consensus is that wisdom teeth have a chewing function just like all the others, and that there is no scientific justification for the belief that they serve no purpose.

So, why do wisdom teeth cause a substantial number of people problems? Scientists who have researched the subject have discovered that wisdom tooth difficulties have manifested themselves in different ways among human communities at different times. It is now understood that the problem was seldom seen in pre-industrial societies. It

has been discovered that the way in which soft foodstuffs have come to be preferred to harder ones, over the last few hundred years in particular, has negatively affected the way the human jaw develops. It has thus been realised that most wisdom tooth troubles emerge as a result of jaw development problems relating to dietary habits.

It is also known that society's nutritional habits also have negative effects on our other teeth. For instance, the increasing consumption of foodstuffs high in sugar and acid has increased the rate that other teeth decay. However, that fact does not make us think that all our teeth have somehow "atrophied." The same principle applies to wisdom teeth. Problems with these teeth stem from contemporary dietary customs, not from any evolutionary "atrophy."

13

HOW DO THE COMPLEX STRUCTURES OF THE MOST ANCIENT CREATURES DEMOLISH THE THEORY OF EVOLUTION?

LIVING things form a chain in the fossil record. When we look at these from the oldest to the more recent, they emerge in the form of micro organisms, invertebrate sea creatures, fish, amphibians, reptiles, birds, and mammals. Proponents of the theory of evolution describe this chain in a prejudiced manner, and try to present it as proof of the theory of evolution. They claim that living things developed from simple to complex forms, and that during this process a wide variety in living species came about. For example, evolutionists suggest that the fact that no human fossils are to be found when 300-million-year-old fossil beds are examined is in some way proof of this. The Turkish evolutionist Professor Aykut Kence says:

> Do you wish to invalidate the theory of evolution? Then go and find some human fossils from the Cambrian Age! Anyone who does that will disprove the theory of evolution, and even win the Nobel Prize for his discovery.[56]

Development from the primitive to the complex is an imaginary concept

Let us examine the evolutionist logic that pervades Professor Kence's words. The statement that living things developed from primitive forms to complex ones is an evolutionist prejudice that in no way reflects the truth. The American professor of biology Frank L. Marsh, who considered that evolutionist claim, maintains in his book *Variation and Fixity in Nature*, that **living things cannot be arranged in a continuous, unbroken series from simple to complex.**[57]

The fact that almost all known animal phyla suddenly emerged in the Cambrian period is strong evidence against evolutionist claims in this regard. Furthermore, those creatures which suddenly emerged possessed complex bodily structures, not simple ones—the exact opposite of the evolutionist assumption.

Trilobites belonged to the *Arthropoda* phylum, and were very complicated creatures with hard shells, articulated bodies, and complex organs. The fossil record has made it possible to carry out very detailed studies of trilobites' eyes. The trilobite eye is made up of hundreds of tiny facets, and



A trilobite fossil.

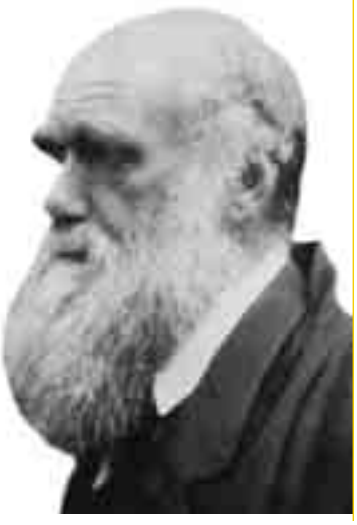


In Darwin's time, the Cambrian Age was included in the Silurian Age, and Darwin remained silent in the face of the complex structures of the living things that suddenly emerged at that time. In the succeeding 150 years, Darwinism's dilemma on this matter has grown even greater. Above: The Silurian Age by Zdenek Burian.

each one of these contains two lens layers. This eye structure is a real wonder of design. David Raup, a professor of geology at Harvard, Rochester, and Chicago Universities, says, "the trilobites 450 million years ago used an optimal design which would require a well trained and imaginative optical engineer to develop today."[58]

Another interesting aspect of the matter is that flies in our day possess the same eye structure. In other words, the same structure has existed for the last 520 million years.

Very little was known about this extraordinary situation in the Cambrian Age when Charles Darwin was writing *The Origin of Species*. Only since Darwin's time has the fossil record



Charles Darwin

revealed that life suddenly emerged in the Cambrian Age, and that trilobites and other invertebrates came into being all at once. For this reason, Darwin was unable to treat the subject fully in the book. But he did touch on the subject under the heading "On the sudden appearance of groups of allied species in the lowest known fossiliferous strata," where he wrote the following about the Silurian Age (a name which at that time encompassed what we now call the Cambrian):

> For instance, I cannot doubt that all the Silurian trilobites have descended from some one crustacean, which must have lived long before the Silurian age, and which probably differed greatly from any known animal… Consequently, **if my theory be true**, it is indisputable that before the lowest Silurian stratum was deposited, long periods elapsed, as long as, or probably far longer than, the whole interval from the Silurian age to the present day; and that during these vast, yet quite unknown, periods of time, the world swarmed with living creatures. To the question why we do not find records of these vast primordial periods, I can give no satisfactory answer.[59]



The Origin of Species

Darwin said "If my theory be true, it is indisputable that the world swarmed with living creatures before the Silurian Age." As for the question of why there were no fossils of these creatures, he tried to supply an answer throughout his book, using the excuse that "the fossil record is very lacking." But nowadays the fossil record is quite complete, and it clearly reveals that creatures from

the Cambrian Age did not have ancestors. This means that we have to reject that sentence of Darwin's which begins "If my theory be true." Darwin's hypotheses were invalid, and for that reason, his theory is mistaken.

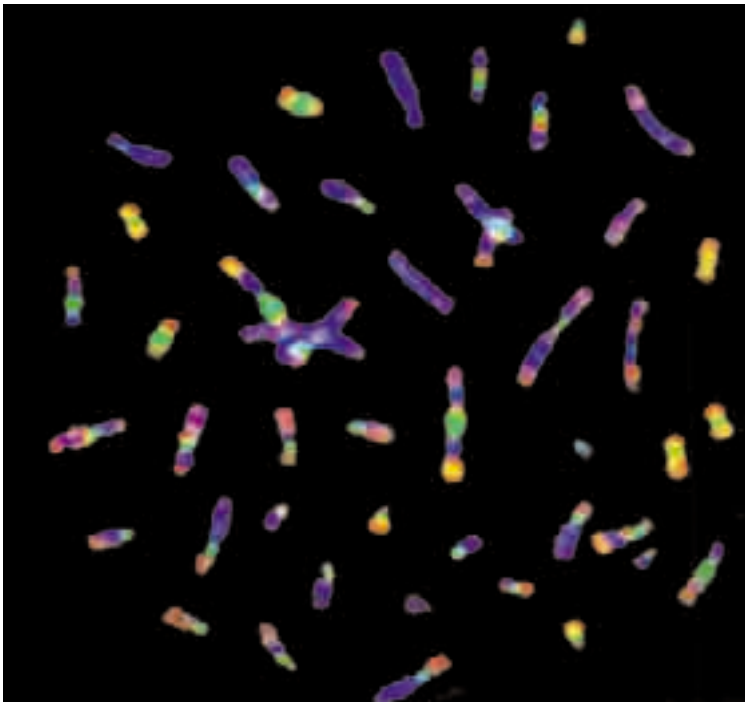
Another example demonstrating that life did not develop from primitive forms to complex ones and that life was already exceedingly complex from the moment when it first emerged is the shark, which the fossil record shows to have emerged some 400 million years ago. This animal possesses superior features not even seen in animals created millions of years after it, such as the way it can regenerate lost teeth. Another example is the astonishing resemblances between mammals' eyes and those of octopuses which lived on Earth millions of years before mammals.

These examples make it clear that living species cannot be neatly arranged from the primitive to the complex.

This fact also emerged as the result of analyses of studies of living things' forms, functions, and genes. For instance, when we examine the very lowest levels of the fossil record from the point of view of shape and size, we see many creatures that were much larger than those which came later (such as dinosaurs).

When we look at the functional properties of living things, we see exactly the same thing. As regards structural development, the ear is an example that disproves the claim of "development from the primitive to the complex." Amphibians possess a middle-ear space, yet reptiles, which emerged after them, have a much simpler system, based on a single small bone, and have no middle-ear space at all.

Genetic studies have produced similar results. Research has demonstrated that the number of chromosomes has no relation to animals' complexity. For example, human beings pos-



The number of chromosomes is not directly related to the complex structures of living things. This is a fact that invalidates the claims of the theory of evolution.

sess 46 chromosomes, the copepode six, and the microscopic creature called radiolaria exactly 800.

Living things were created at the most "appropriate" time for them

The real fact that emerges from examination of the fossil record is that living things emerged in the periods most suitable for them. God has designed all creatures superbly, and has made them well-suited to meet their needs at the times when they emerged on the Earth.

Let us consider one example of this: the Earth at the time when the oldest bacteria fossils emerge, some 3.5 billion years

ago. Atmospheric and temperature conditions at the time were not at all suited to support complex creatures or human beings. That also applies to the Cambrian Age, the finding of human fossils from which, according to the evolutionist Kence, would invalidate the theory of evolution. This period, which refers to some 530 million years ago, was definitely unsuitable for human life. (There were no land animals at all at that time.)

The situation is the same in the great majority of succeeding periods. Examination of the fossil record shows that conditions able to support human life have only existed for the last few million years. The same applies to all other living things. Each living group emerged when the appropriate conditions for it had been arrived at—in other words, "when the time was right."

Evolutionists make an enormous contradiction in the face of that fact, trying to explain it as if these appropriate conditions themselves had created living things, whereas the coming about of "appropriate conditions" only meant that the right time had come. Living things can only emerge with a conscious intervention—in other words, a supernatural creation.

For this reason, the emergence of living things by stages is evidence not of evolution, but of the infinite knowledge and wisdom of God, Who created them. Every living group created established the appropriate conditions for the next group to emerge, and an ecological balance with all living things was set up for us over a long period of time.

On the other hand, we must be aware that this long period of time is only long to us. For God it is but a single "moment." Time is a concept that only applies to created things. As the creator of time itself, God is not bound by it. (For more details see Harun Yahya: *Timelessness and the Reality of Fate*.)

If evolutionists wish to show that one species turned into another, then showing that living things emerged step by step on the Earth is no good. The evidence they have to come up with is fossils of the intermediate forms that link these different species together. A theory that maintains that invertebrates turned into fish, fish into reptiles, and reptiles into birds and mammals has to find the fossils to prove it. Darwin accepted that, and wrote that countless examples of these would have to be found, even though none were so far available. In the 150 years that have passed since then, no intermediate forms have been found. As the evolutionist paleontologist Derek W. Ager has admitted, the fossil record shows "**not gradual evolution, but the sudden explosion of one group at the expense of another**."[60]

In conclusion, natural history reveals that living things did not come about by chance, but that they were created, stage by stage, over long periods over time. This is in complete agreement with the information about creation given in the Qur'an, in which God reveals that he created the universe and all living things in "six days":

> **God is He Who created the heavens and the Earth and everything between them in six days and then established Himself firmly upon the Throne. You have no protector or intercessor apart from Him. So will you not pay heed? (Qur'an, 32: 4)**

The word "day" in the verse (yawm in Arabic) also means a long period of time. In other words, the Qur'an notes that all of nature was created over different times, not all at once. Modern geological discoveries paint a picture that confirms this.



WHY IS DENYING THE THEORY OF EVOLUTION PORTRAYED AS REJECTING DEVELOPMENT AND PROGRESS?

THE word "evolution" has been used in several senses in recent times. A social aspect has been added to it, for instance, and the word has come to mean human progress and technological development. There is nothing wrong with the concept of "evolution" when it is used in this sense. There is no doubt that man will use his intelligence, knowledge, and strength to develop over time. The sum of human knowledge will grow from generation to generation. In the same way that this is not evidence for the theory of evolution itself, which seeks to explain the emergence of life by chance, neither does it conflict in any way with the fact of creation.

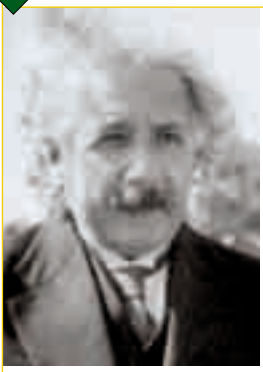
Yet evolutionists engage in a facile word game here, and

confuse a true concept with a false one. For example, it is true to state that "On account of man's long years of living as a social being, his knowledge, culture, and technology are in a constant state of development." (We must remember, however, that there can be regression over time as well as progress. Sociologically speaking, there have been times of progress, as well as times of stagnation and regression.) However, the claim that "In the same way as man has developed and progressed, living species have also advanced and changed over time" is completely false. Although it is perfectly logical and scientific to say that, as a thinking being, man's knowledge has increased and been passed on to subsequent generations, allowing constant progress, it is utterly senseless to claim that living species developed and evolved by chance and coincidence, in accordance with uncontrolled and unconscious natural conditions.

The greatest names in the advancement of science were all creationists

No matter how much evolutionists try to identify themselves with concepts such as innovation and progress, history has shown that the real initiators of innovation and progress have always been faithful scientists who have believed in divine creation.

We see the mark of such believing scientists at every point of scientific progress. **Leonardo da Vinci, Copernicus, Kepler,** and **Galileo**, who opened a new era in astronomy, **Cuvier**, the founder of paleontology, **Linnaeus**, the founder of the modern classification system for plants and animals, **Isaac Newton**, the discoverer of the law of gravity, **Edwin Hubble**, who discovered the existence of the galaxies and the expansion of the universe, and many others have believed in God and that life and



Einstein



Max Planck



Leonardo Da Vinci



Kepler

the universe were created by Him.

One of the greatest scientists of the twentieth century, **Albert Einstein**, said:

I cannot conceive of a genuine scientist without that profound faith. The situation may be expressed by an image: science without religion is lame...[61]

The German **Max Planck**, who laid the foundations of modern physics, said:

Anybody who has been seriously engaged in scientific work of any kind realises that over the entrance to the gates of the temple of science are written the words: Ye must have faith. **It is a quality which the scientist cannot dispense with**.[62]

The history of science reveals that change and progress have been the work of creationist scientists. On the other hand, of course, scientific developments in the twentieth and twenty-first centuries especially have allowed us to come by countless pieces of evidence of creation. Modern science and technology have allowed us to discover the fact that the universe came into being from nothing, in other words that it was "created." It is a fact accepted by the whole scientific world that the universe came into being and developed as a result of the explosion of one single point. In this way, the model of the infinite universe, with no beginning or end, maintained by materialists under the primitive scientific conditions of the nineteenth century has been destroyed. It has been realised that the universe was created, as it says in the Qur'an, and that it has a beginning and frontiers and

has expanded over time. The Qur'an expresses this fact thus:

> **Do those who disbelieve not see that the heavens and the Earth were sewn together and then We unstitched them and that We made from water every living thing? So will they not believe?** (Qur'an, 21: 30)

> **It is We Who have built the universe with (Our Creative) power, and verily, it is We Who are steadily expanding it.** (Qur'an, 51: 47)

It was again twentieth century scientific progress that allowed us to discover more evidence of the design in life. The electron microscope revealed the structure of the cell, the smallest unit of life, as well as the parts that comprise it. The discovery of DNA demonstrated the infinite intelligence in the cell. Biochemical and physiological advances have shown the flawless workings at the molecular level of the body, and its superior design which cannot be explained by anything other than creation.

As opposed to all this, it was the primitive state of science 150 years ago that prepared the ground for the formation of the theory of evolution.

In conclusion, it is impossible to consider those who believe in creation, and who constantly provide new evidence of it, as being opposed to progress, development, and science. On the contrary, such people are their greatest supporters. Those who actually oppose progress are those who turn their backs on all the scientific evidence and defend the theory of evolution, which is nothing but an unsubstantiated fantasy.



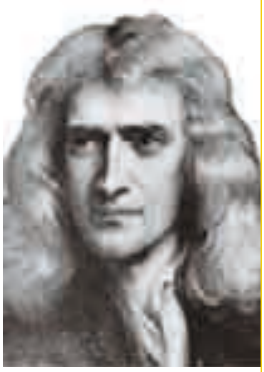
Galileo



Mendel



Pasteur



Newton

15

WHY IS IT MISTAKEN TO THINK THAT GOD COULD HAVE CREATED LIVING THINGS BY EVOLUTION?

WHILE it has been scientifically proven that the magnificent design apparent in all living and non-living things in the universe could not have come about by the blind forces of nature and chance, some people nevertheless claim that there is indeed a Creator, but that He created life through an evolutionary process.

It is evident that God, the Almighty, created the whole universe and life. It is His decision whether creation should be instantaneous or by stages. We can only understand how it happened by means of the information God has given us (in other words, from the verses of the Qur'an), and the scientific evidence apparent in nature.



The Qur'an contains not one verse about creation being based on evolution.

When we look at these two sources, we see no case for "creation by evolution."

God has revealed many verses in the Qur'an which deal with the creation of man, life, and the universe. None of these verses contains any information about creation through evolution. In other words, not one verse indicates that living things came about by evolving from one another. On the contrary, it is revealed in those verses that life and the universe were brought into being by God's command "Be!"

Scientific discoveries have also revealed that "creation by means of evolution" is out of the question. The fossil record shows that different species emerged not by evolving from one another, but independently, suddenly, and with all their individual structures. In other words, creation is different for every species.

If there were such a thing as "creation by means of evolution," we should be able to see the proof of it today. God has created everything in a particular order, within a framework of causes and laws. For instance, it is most certainly God Who makes ships float on water. However, when we look for the cause of this, we see that it is the creation of the supporting power of water. It is nothing other than the might of God that allows birds to fly. In fact, when we examine how it happens, we find the laws of aerodynamics. For this reason, if life had been created by a process of various stages, there would obviously be

LIVING FOSSILS





The fossil starfish on the left is 100-150 million years old. It is no different from the modern starfish above.





Today's dragonfly is exactly the same as the 135-million-year-old fossil on the left.

The shark, one of the most dangerous creatures in the sea, and the 400-million-year-old fossil below clearly show that there has been no evolutionary process.





All the fossil discoveries that have been made show that living things have undergone no evolutionary process, that they were created millions of years ago in just the same form as they are now, and that they had no evolutionary ancestors. This fact clearly shows that creation by evolution is quite out of the question.

systems that provide the laws and advances in genetics to explain it. Furthermore, other physical, chemical, and biological laws would be known. There would be proof from laboratory research to show that one living species could turn into another. Yet again, it should be possible thanks to that research to develop enzymes, hormones, and similar molecules that a species lacks in order to bring advantages to it. In addition, it would be possible to create new organelles and structures that the living thing in question had never possessed before.

Laboratory studies would be able to show examples of creatures that had been mutated and actually benefited from the process. We would furthermore see that these mutations could be passed on to subsequent generations and actually become a part of the species. Then again, there would be millions of fossils of intermediate forms that had lived in the past, and there would be living things in our time that had not yet completed their transition processes. In short, there should be countless examples of such a process.

However, there is not a single piece of evidence that one species transmutates into another. As we have already seen, fossil data show that living species emerged all at once, with no ancestors behind them. In the same way as this fact destroys the theory of evolution, which claims that life came about by chance, it also shows the scientific invalidity of the claim that God brought life into being and then it evolved by stages.

God created living things in a supernatural way, by the single command "Be!" Modern science confirms this fact, and proves that living things emerged suddenly on the Earth.

Those who support the idea that "It is possible that God

created living things by means of evolution" are actually trying to build "reconciliation" between creation and Darwinism. They are making a fundamental mistake, however. They are missing the basic logic of Darwinism and the kind of philosophy it serves. Darwinism does not consist of the concept of the transmutation of species. It is actually an attempt to explain the origin of living species by material factors alone. To put it another way, it tries to gain acceptance for the claim that living things are the product of nature, by giving it a scientific veneer. There can be no "common ground" between that naturalistic philosophy and a belief in God. It is a grave error in an effort to seek to find such common ground, to cede ground to Darwinism, and to agree with the false claim that it is a scientific theory. As 150 years of history have shown, Darwinism is the backbone of materialist philosophy and atheism, and no search for common ground will ever change the fact.



Lobster fossils from the Ordovician Age: they are no different from living lobsters.



110-million-year-old fish fossils from the Santana fossil bed in Brazil.

16

WHY IS IT WRONG TO THINK THAT EVOLUTION COULD BE CONFIRMED IN THE FUTURE?

WHEN forced into a corner, some people who support the theory of evolution resort to the claim "Even if scientific discoveries do not confirm the theory of evolution today, such developments will take place in the future."

The basic starting point here is evolutionists' admission of defeat in the scientific arena. Reading between the lines, we can translate as follows: "**Yes, we defenders of the theory of evolution admit that the discoveries of modern science do not support us. For that reason, we can see no alternative but to refer the matter to the future.**"

Yet science does not function by such logic. A scientist

does not first of all blindly devote himself to a theory, hoping that one day the evidence to prove that theory will emerge. Science examines the available evidence and draws conclusions from it. That is why scientists should accept the "design," or the fact of creation in other words, which scientific discoveries have proved.

Despite this, however, evolutionist incitement and propaganda can still influence people, especially those who are not fully conversant with the theory. For this reason, it will be useful to set out the reply in full:

We can consider the validity of the theory of evolution with three basic questions:

1. How did the first living cell emerge?

2. How can one living species turn into another?

3. Is there any evidence in the fossil record that living things underwent such a process?

A great deal of serious research has been carried out during the twentieth century into these three questions, which the theory simply has to answer. What this research has revealed, however, is that the theory of evolution cannot account for life. This will become apparent when we consider these questions one by one.

1. The question of the "first cell" is the most deadly dilemma for the proponents of evolution. Research on the subject has revealed that it is impossible to explain the emergence of the first cell by means of the concept of "chance." Fred Hoyle puts it this way:

> The chance that higher life forms might have emerged in this way is comparable to the chance that a tornado sweep-

ing through a junk-yard might assemble a Boeing 747 from the materials therein.[63]

Let us use an example to see the contradiction evolutionists are involved in. Remember the famous example of William Paley and imagine someone who has never seen a clock in his life, someone on a desert island for instance, who one day comes across one. This person who sees a wall-clock from 100 metres away will not be able to make out exactly what it is, and may be unable to distinguish it from any natural phenomenon thrown up by the wind, sand, and Earth. Yet as that person draws closer, he will understand just by looking at it that it is the product of design. From even closer up, he will be left in absolutely no doubt. The next stage may be to examine the fea-



There is no difference between the absurdity of claiming that a jet could form by chance and that a living cell could do so. The design in a living cell is many times superior to that in a jet created by the best engineers and most advanced robots, with the most developed technology, in the most modern plants.



tures of this object, and the art apparent in it. When he opens it up and has a detailed look, he will see that there is a greater accumulation of knowledge inside it than was apparent from the outside, and that is a product of intelligence. Every subsequent examination will just make that analysis even more certain.

The truth about life that emerges as science advances is in a similar situation. Scientific developments have revealed the perfection in life on the system, organ, tissue, cellular, and even molecular levels. Every new detail we grasp enables us to see the wondrous dimension of this design a little more clearly. Nineteenth-century evolutionists, who took the view that the cell was a little lump of carbon, were in the same situation as that person looking at the clock from 100 metres away. Today, however, it is impossible to find even one scientist who does not admit that each individual part of the cell is a magnificent work of art and design on its own. Even the membrane of a tiny cell, which has been described as a "selective filter," contains enormous intelligence and design. It recognizes the atoms, proteins, and molecules around it as if it possessed a consciousness of its own, and only allows into the cell those which are needed. (For further details, see Harun Yahya's *Consciousness in the Cell*.) Unlike the limited intelligent design in the clock, living organisms are stunning artifacts of intelligence and design. Far from proving evolution, the ever wider-ranging and detailed research that is carried out into living structures, only some of whose make-up and functions have been uncovered so far, allows us to understand the truth of creation even better.

2. Evolutionists maintain that one species can turn into another by means of mutation and natural selection. All the re-

search carried out on the matter has shown that neither mechanism has any evolutionary effect whatsoever. Colin Patterson, the senior paleontologist at the Natural History Museum in London, stresses the fact in these words:

> **No one has ever produced a species by the mechanisms of natural selection.** No one has ever got near it, and most of the current argument in neo-Darwinism is about this question. [64]

Research into mutation shows that it has no evolutionary properties. The American geneticist B. G. Ranganathan says:

> First, genuine mutations are very rare in nature. Secondly, most mutations are harmful since they are random, rather than orderly changes in the structure of genes; any random change in a highly ordered system will be for the worse, not for the better. For example, if an earthquake were to shake a highly ordered structure such as a building, there would be a random change in the framework of the building, which, in all probability, would not be an improvement.[65]

As we have seen, the mechanisms that the theory of evolution suggests for the formation of species are completely ineffective, and actually harmful. It has been understood that these mechanisms, which were proposed when science and technology had not yet advanced to the level necessary to show that the claim was nothing but the product of fantasy, have no developmental or evolutionary effects.

3. Fossils also show that life did not emerge as the result of any evolutionary process, but that it came about suddenly, the product of perfect "design." All the fossils that have ever been found confirm this. Niles Eldredge, the well-known paleontolo-

gist from Harvard University and curator of the American Museum of Natural History, explains that there is no possibility that any fossils that might be found in the future could change the situation:

> The record jumps, and all the evidence shows that the record is real: the gaps we see reflect real events in life's history—not the artifact of a poor fossil record. [66]

Another American scholar, Robert Wesson, states in his 1991 book *Beyond Natural Selection*, that "the gaps in the fossil record are real and phenomenal." He elaborates this claim in this way:

> The gaps in the record are real, however. The absence of a record of any important branching is quite phenomenal. Species are usually static, or nearly so, for long periods, species seldom and genera never show evolution into new species or genera but replacement of one by another, and change is more or less abrupt. [67]

In conclusion, some 150 years have gone by since the theory of evolution was first put forward, and all subsequent scientific developments have worked against it. The more science has examined the details of life, the more evidence for the perfection of creation has been found, and the more it has been understood that the emergence of life and its subsequent variation by chance is quite impossible. Every piece of research reveals new evidence of the design in living things, and makes the fact of creation ever clearer. Every decade that has passed since Darwin's time has just revealed the invalidity of the theory of evolution even more.

In short, scientific advances do not favour the theory of evolution. For that reason, further developments in the future will not do so either, but will demonstrate its invalidity even further.

It remains to say that the claims of evolution are not something that science has not yet solved or explained, but will be able to explain in the future. On the contrary, modern science has disproved the theory of evolution in all areas and demonstrated that it is impossible from all points of view for such an imaginary process ever to have taken place. To claim that such an untenable belief will be proven in the future is nothing but the product of the imaginative and utopian mindsets of those Marxist and materialist circles that see evolution as underpinning their ideologies. They are merely trying to console themselves in their terrible despair.

For this reason, the idea that "science will prove evolution in the future" is no different from believing that "science will one day show that the Earth rests on the back of an elephant."

17

WHY IS METAMORPHOSIS NOT EVIDENCE OF EVOLUTION?

SOME creatures undergo physical changes to allow them to survive and adapt to different natural conditions at different times. This process is known as metamorphosis. People with insufficient knowledge of biology and evolutionist claims also sometimes try to portray the process as evidence for the theory of evolution. Those sources which cite metamorphosis as "an example of evolution" are superficial, narrow-based works of propaganda which seek to mislead those who do not possess sufficient information on the subject, juvenile evolutionists, or a few ignorant Darwinist biology teachers. Scientists who are considered experts on evolution, and who thus know more about the

dilemmas and contradictions inherent in the theory, hesitate to even refer to this ridiculous claim. That is because they know how senseless it is…

Butterflies, flies, and bees are some of the best-known creatures that undergo metamorphosis. Frogs, which start life in water and then live on land, are another example. This has nothing to do with evolution, because the theory tries to account for the differentiation between living things in terms of chance mutations. Metamorphosis, however, bears no similarity at all to that claim, being a preplanned process which has nothing to do with mutation or chance. It is not chance that brings metamorphosis about, but genetic data which are built-in in the creature from the moment it is born. The frog, for example, possesses the genetic information to allow it to live on land while it is still living underwater. Even while still a larva, the mosquito possesses the genetic information regarding its pupa and adult states. The same thing applies to all creatures that undergo metamorphosis.







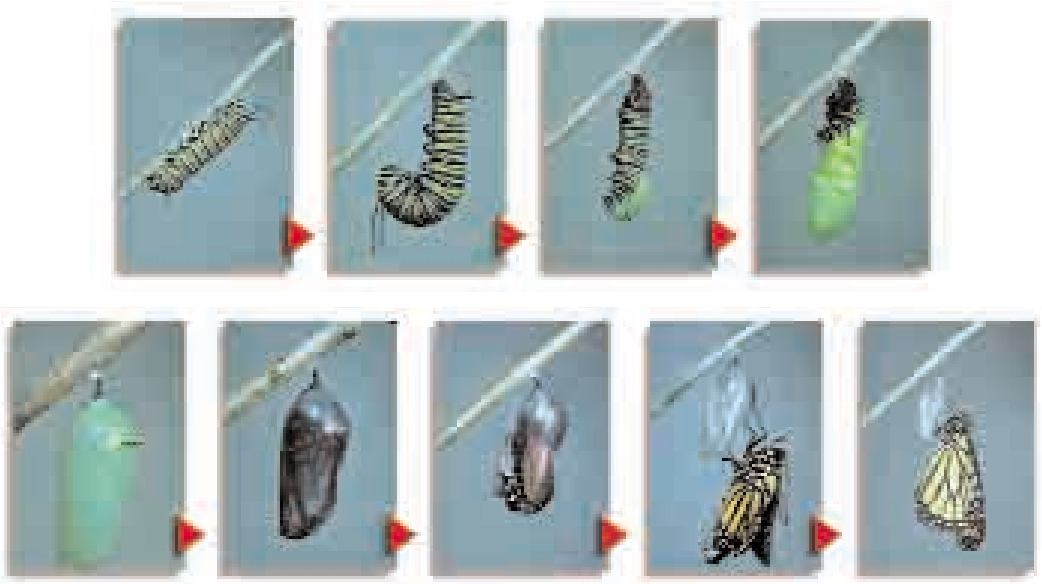


Some creatures that undergo metamorphosis: the frog, the butterfly, the bee, the mosquito.

Metamorphosis is evidence for creation

Recent scientific research into metamorphosis has shown that it is a complex process controlled by different genes. As regards the metamorphosis of the frog, for instance, the relevant processes in the tail alone are controlled by more than a dozen genes. This means that this process comes about thanks to several components working together. This is a biological process that bears the feature of "irreducible complexity," which shows that metamorphosis is proof of creation.

"**Irreducible complexity**" is a concept that has been given its place in the scientific literature by Professor Michael Behe, a biochemist who is known for his research proving the invalidity of the theory of evolution. What it means is that complex or-



People who try to portray metamorphosis as "evidence of evolution" know nothing about biology and the theory of evolution. Metamorphosis is a "planned change" encoded inside genetic information, and bears no similarity to evolution, which means "coincidental change." Metamorphosis is an example of "irreducible complexity," and is evidence that disproves evolution.



Prof. Michael Behe

gans and systems function by the working together of all the component parts that make them up, and that if even the smallest part ceases to function, so will the whole organ or system. It is impossible for such complex structures to have emerged by chance, with tiny changes over time, as the theory of evolution maintains. That is what happens in metamorphosis. The process of metamorphosis happens through exceedingly sensitive balances and timings in hormones which are in turn affected by different genes. The creature will pay for even the tiniest error with its life. It is impossible to believe that such a complex process could have come about by chance and by stages. Since even a tiny error will cost the animal its life, it is impossible to speak in terms of a "trial and error mechanism," or natural selection, as evolutionists maintain. No creature can hang around for millions of years waiting for its missing components to come about by chance.

Bearing this fact in mind, it is also apparent that the subject constitutes no evidence at all for evolution, as some people who are ill-informed about metamorphosis assume it to do. On the contrary, when the complexity of the process and the systems that control it are taken into consideration, animals which undergo metamorphosis can be seen to be clear evidence for creation.



WHY IS IT IMPOSSIBLE TO ACCOUNT FOR DNA BY "CHANCE"?

THE level of scientific knowledge we have arrived at today shows that the evident design and complex systems in living things make it impossible for them to have emerged by chance. For instance, thanks to the recent "Human Genome Project," the marvelous design and the enormous information content in human genes have been revealed for all to see.

In the framework of that project, scientists from many countries, from the United States to China, worked for 10 years to decipher one by one the 3 billion chemical codes in DNA. As a result, nearly all the information in human genes has been set out in its correct order.

Although this is a very exciting and important development, as Dr. Francis Collins, who leads the Human Genome



Project states, so far only the first step has been taken in the decoding of the information in DNA.

In order to understand why it took 10 years and the work of hundreds of scientists to uncover the codes that make up this information, we have to understand the magnitude of the information contained within DNA.



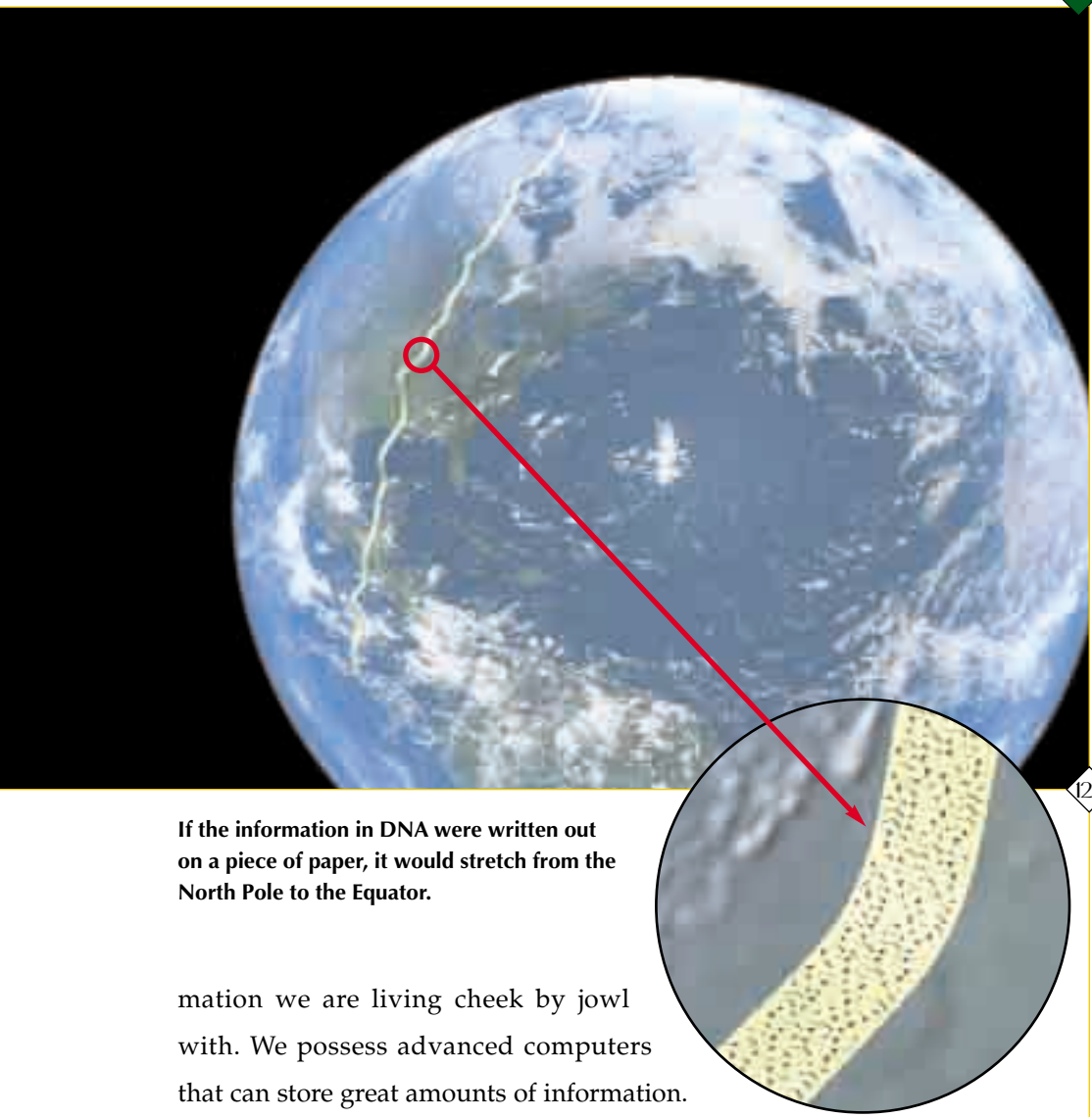
DNA reveals the existence of an infinite source of knowledge

There is enough information in the DNA of a single human cell to fill an encyclopedia of one million pages. It would be impossible to read it all in one lifetime. If one person set out to read one DNA code per second, non-stop, all day every day, it would take him 100 years. That is because the encyclopedia in question possesses nearly three billion different codes. If we wrote down all the information in DNA on paper, it would stretch from the North Pole to the Equator. That means some 1,000 large volumes—more than enough to fill a big library.

Even more important, all this information is contained in the nucleus of each and every cell, which means that as each individual consists of some 100 trillion cells, there are 100 trillion versions of the same library.

If we wish to compare this treasury of information with the level of knowledge so far reached by man, it is impossible to provide any example of the same magnitude. An unbelievable picture presents itself: 100 trillion x 1,000 books! That is more than the number of grains of sand in the world. Furthermore, if we multiply that number by the six billion people currently living on the Earth, and the billions more who have ever lived, then the number is beyond our capacity to grasp, and the amount of information stretches to infinity.

These examples are an indication of what imposing infor-



If the information in DNA were written out on a piece of paper, it would stretch from the North Pole to the Equator.

mation we are living cheek by jowl with. We possess advanced computers that can store great amounts of information. However, when we compare DNA to these computers, we are amazed to see that the most modern technology—the product of the cumulative human labour and knowledge over the centuries—does not even possess the storage capacity of a single cell.

Gene Myers is one of the most prominent experts of Celera Genomics, the company that carried out the Human Genome project. His words regarding the outcome of the project are a



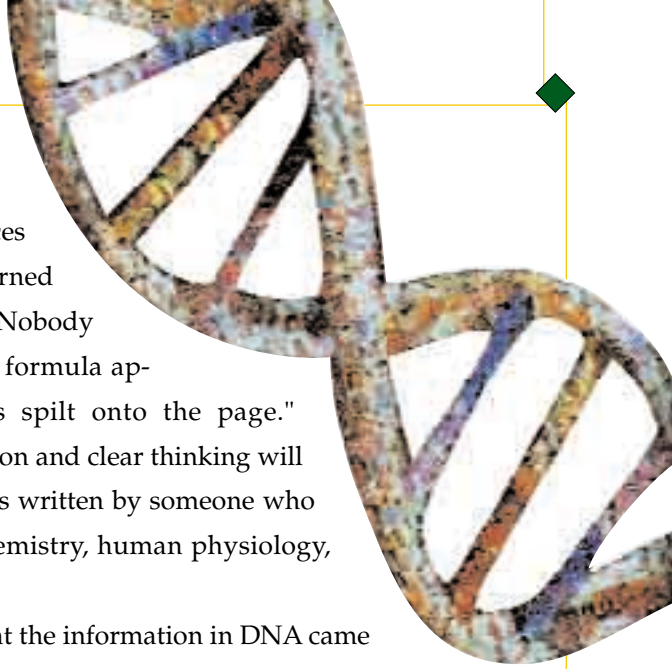


statement of the great knowledge and design in DNA: "**What really astounds me is the architecture of life…The system is extremely complex. It's like it was designed… There's a huge intelligence there.**" [68]

Another interesting aspect is that all life on the planet has been produced according to the coded descriptions written in this same language. No bacterium, plant, or animal is formed without its DNA. It is quite evident that all of life emerges as the result of descriptions that employ the same language and stemming from the same source of knowledge.

This leads us to an obvious conclusion. All living things in the world live and multiply according to information created by one single intelligence.

This makes the theory of evolution utterly meaningless. That is because the foundation of evolution is "chance," but chance cannot create information. If one day the formula of a medicine that can cure cancer were found on a piece of paper,



all of mankind would join forces to discover the scientist concerned and even give him an award. Nobody would think, "I wonder if the formula appeared when some ink was spilt onto the page." Everybody who possesses reason and clear thinking will think that that the formula was written by someone who had made a deep study of chemistry, human physiology, cancer, and pharmacology.

The evolutionist claim that the information in DNA came about by chance is completely irrational, and is equivalent to saying that the formula on the paper also came about by chance. DNA contains the detailed molecular formulae of 100,000 types of proteins and enzymes, together with the delicate order governing how these will be used during production. Alongside these, it contains the production plans for the message-carrier hormones and the inter-cellular communications protocols they are used in, and all kinds of other complex and specified information.

To claim that DNA and all the information within it came about by chance events and natural causes reflects either total ignorance of the subject or materialist dogmatism. The idea that a molecule such as DNA, with all the magnificent information and complex structure it contains, could be the product of chance is not even worth taking seriously. Unsurprisingly, evolutionists try to gloss over the subject of the source of life, as with so many other subjects, by describing it as an "unsolved secret."



WHY IS IT THAT BACTERIAL RESISTANCE TO ANTIBIOTICS IS NOT AN EXAMPLE OF EVOLUTION?

ONE of the biological concepts that evolutionists try to present as evidence for their theory is the resistance of bacteria to antibiotics. Many evolutionist sources mention antibiotic resistance as an example of the development of living things by advantageous mutations. A similar claim is also made for the insects which build immunity to insecticides such as DDT.

However, evolutionists are mistaken on this subject too.

Antibiotics are "killer molecules" that are produced by microorganisms to fight other microorganisms. The first antibiotic was penicillin, discovered by Alexander Fleming in 1928. Fleming realised that mould produced a molecule that killed the *Staphylococcus* bacterium, and this discovery marked a turning point in the world of medicine. Antibiotics derived from

microorganisms were used against bacteria and the results were successful.

Soon, something new was discovered. Bacteria build immunity to antibiotics over time. The mechanism works like this: A large proportion of the bacteria that are subjected to antibiotics die, but some others, which are not affected by that antibiotic, replicate rapidly and soon make up the whole population. Thus, the entire population becomes immune to antibiotics.

Evolutionists try to present this as "the evolution of bacteria by adapting to conditions."

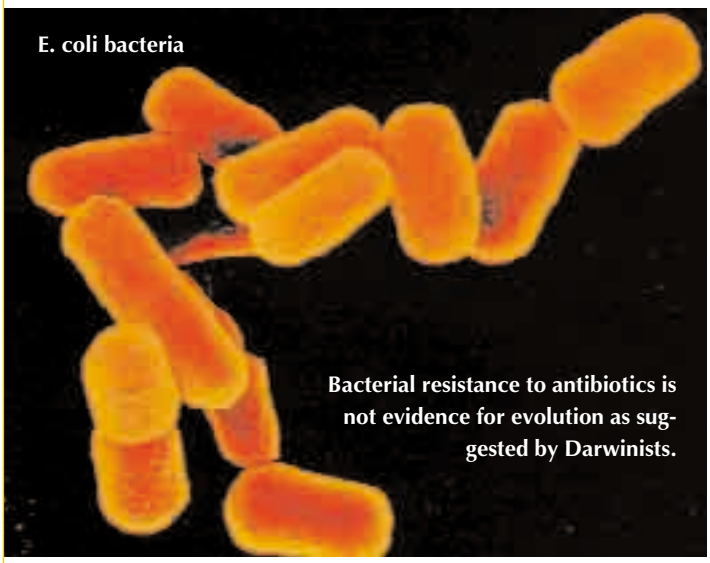
The truth, however, is very different from this superficial interpretation. One of the scientists who has done the most detailed research into this subject is the Israeli biophysicist Lee Spetner, who is also known for his book *Not by Chance* published in 1997. Spetner maintains that the immunity of bacteria comes about by two different mechanisms, but neither of them constitutes evidence for the theory of evolution. These two mechanisms are:

1) The transfer of resistance genes already extant in bacteria.

2) The building of resistance as a result of losing genetic data because of mutation.

Professor Spetner explains the first mechanism in an article published in 2001:

> Some microorganisms are endowed with genes that grant resistance to these antibiotics. This resistance can take the form of degrading the antibiotic molecule or of ejecting it from the cell... [T]he organisms having these genes can transfer them to other bacteria making them resistant as well. Although the resistance mechanisms are specific to a particular antibiotic, most pathogenic bacteria have... succeeded in accumulating several sets of genes granting them





resistance to a variety of antibiotics. [69]

Spetner then goes on to say that this is not "evidence for evolution":

> The acquisition of antibiotic resistance in this manner... is not the kind that can serve as a prototype for the mutations needed to account for Evolution… The genetic changes that could illustrate the theory must not only add information to the bacterium's genome, they must add new information to the biocosm. The horizontal transfer of genes only spreads around genes that are already in some species. [70]

So, we cannot talk of any evolution here, because no new genetic information is produced: genetic information that already exists is simply transferred between bacteria.

The second type of immunity, which comes about as a result of mutation, is not an example of evolution either. Spetner writes:

> ... [A] microorganism can sometimes acquire resistance to an antibiotic through a random substitution of a single nucleotide... Streptomycin, which was discovered by Selman

> Waksman and Albert Schatz and first reported in 1944, is an antibiotic against which bacteria can acquire resistance in this way. But although the mutation they undergo in the process is beneficial to the microorganism in the presence of streptomycin, it cannot serve as a prototype for the kind of mutations needed by NDT [Neo-Darwinian Theory]. The type of mutation that grants resistance to streptomycin is manifest in the ribosome and degrades its molecular match with the antibiotic molecule. [71]

In his book *Not by Chance*, Spetner likens this situation to the disturbance of the key-lock relationship. Streptomycin, just like a key that perfectly fits in a lock, clutches on to the ribosome of a bacterium and inactivates it. Mutation, on the other hand, decomposes the ribosome, thus preventing streptomycin from holding on to the ribosome. Although this is interpreted as "bacteria developing immunity against streptomycin," this is not a benefit for the bacteria but rather a loss for it. Spetner writes:

> This change in the surface of the microorganism's ribosome prevents the streptomycin molecule from attaching and carrying out its antibiotic function. It turns out that this degradation is a loss of specificity and therefore a loss of information. The main point is that Evolution… cannot be achieved by mutations of this sort, no matter how many of them there are. Evolution cannot be built by accumulating mutations that only degrade specificity. [72]

To sum up, a mutation impinging on a bacterium's ribosome makes that bacterium resistant to streptomycin. The reason for this is the "decomposition" of the ribosome by mutation. That is, no new genetic information is added to the bacterium. On the contrary, the structure of the ribosome is decomposed, that is to say, the bacterium becomes "disabled." (Also, it has been discovered that the ribosome of the mutated bacterium is

less functional than that of a normal bacterium.) Since this "disability" prevents the antibiotic from attaching onto the ribosome, "antibiotic resistance" develops.

Finally, there is no example of mutation that "develops the genetic information." Evolutionists, who want to present antibiotic resistance as evidence for evolution, treat the issue in a very superficial way and are thus mistaken.

The same situation holds true for the immunity that insects develop to DDT and similar insecticides. In most of these instances, immunity genes that already exist are used. The evolutionary biologist Francisco Ayala admits this fact, saying, "**The genetic variants required for resistance to the most diverse kinds of pesticides were apparently present in every one of the populations exposed to these man-made compounds.**"[73] Some other examples explained by mutation, just as with the ribosome mutation mentioned above, are phenomena that cause "genetic information deficit" in insects.

In this case, it cannot be claimed that the immunity mechanisms in bacteria and insects constitute evidence for the theory of evolution. That is because the theory of evolution is based on the assertion that living things develop through mutations. However, Spetner explains that neither antibiotic immunity nor any other biological phenomena indicate such an example of mutation:

> The mutations needed for macroevolution have never been observed. No random mutations that could represent the mutations required by Neo-Darwinian Theory that have been examined on the molecular level have added any information. The question I address is: Are the mutations that have been observed the kind the theory needs for support? The answer turns out to be NO![74]



WHAT KIND OF RELATIONSHIP IS THERE BETWEEN CREATION AND SCIENCE?

As we have shown in all the questions we have considered so far, the theory of evolution is completely at odds with scientific discoveries. This theory, born of the primitive level of science in the nineteenth century, has been completely invalidated by successive scientific discoveries.

Those evolutionists who are blindly devoted to the theory look for a solution in demagogy, since no scientific foundation is left to them. The most frequently resorted to of these is the clichéd slogan that "creation is a faith, so it cannot be considered part of science." The claim goes that evolution is a scientific theory, whereas creation is just a belief. However, this repetition of "evolution is science, creation is a belief" stems from a totally erroneous perspective. Those who keep repeating that are confus-

ing science and materialist philosophy. They believe that science must remain within the borders of materialism, and that those who are not materialist have no right to make any statements at all. However, science itself completely rejects materialism.

Studying matter is not the same as being a materialist

Let us first briefly define materialism in order to examine the matter in more detail. Materialism is a philosophy that has existed since Ancient Greece and is based on the idea that matter is all that exists. According to materialist philosophy, matter has always existed and will continue to do so for all time. Nothing exists apart from matter. This is not a scientific claim, however, because it cannot be subjected to experiment and observation. It is simply a belief, a dogma.

However, this dogma became mixed up with science in the nineteenth century, and even came to be the basic foundation of science. Yet science is not compelled to accept materialism. Science studies nature and the universe, and produces results without being limited by any philosophical classification.

In the face of this, some materialists frequently take refuge in a simple word game. They say, "Matter is the only subject of study for science, so it has to be materialist." Yes, science only studies matter, but "studying matter" is very different from "being a materialist." That is because when we study matter, we realise that matter contains knowledge and design so great that they could never have been produced by matter itself. We can understand that this knowledge and design are the result of an





Like contemporary materialists, Democritus was deceived into thinking that matter had existed forever, and that nothing existed but matter.

intelligence, even if we cannot see it directly.

For instance, let us imagine a cave. We do not know if anyone has been in it before us. If, when we enter this cave, there is nothing in it but dust, earth, and stones, we can infer that there is nothing but randomly distributed matter there. However, if there are

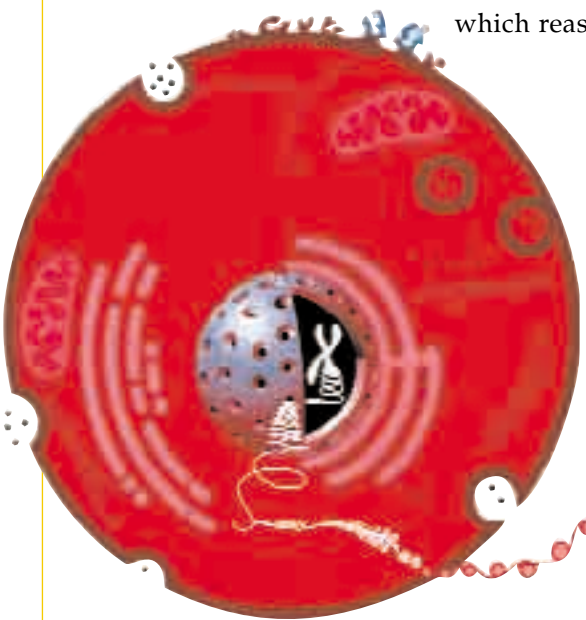


expertly produced pictures in stunning colours on the walls, we may assume that an intelligent entity has been there before us. We may not be able to see that entity directly, but we can infer its existence from what it produces.

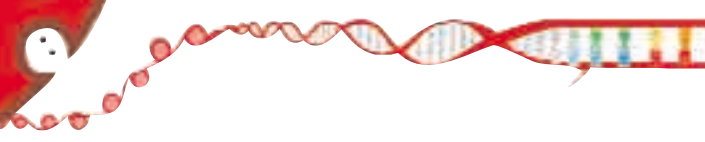
Science has refuted materialism

Science studies nature in the same way as shown in that example. If all the design in nature could only be explained by material factors, then science could confirm materialism. However, modern science has revealed that there is design in nature that cannot be explained by material factors, and that all matter contains a design brought into being by a Creator.

For example, all experiments and observation prove that matter could not by itself have given rise to life, for which reason life must stem from a meta-



If matter were capable of giving rise to life on its own, as materialists claim, then it should be possible to synthesise life in laboratory conditions. However, not even one organelle in a cell can be reproduced in the laboratory, let alone a complete cell.

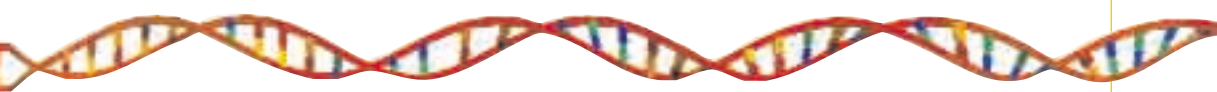


physical creation. All evolutionist experiments in this direction have ended in failure. Life can never have been created from inanimate matter. The evolutionist biologist Andrew Scott makes the following admission on the subject in the well-known journal *New Scientist*:

> Take some matter, heat while stirring and wait. That is the modern version of Genesis. The "fundamental" forces of gravity, electromagnetism and the strong and weak nuclear forces are presumed to have done the rest... But how much of this neat tale is firmly established, and how much remains hopeful speculation? In truth, the mechanism of almost every major step, from chemical precursors up to the first recognizable cells, is the subject of either controversy or complete bewilderment.[75]

The root of life is based on speculation and debate because materialist dogma insists that life is the product of matter. Yet the scientific facts show that matter has no such power. Professor Fred Hoyle, an astronomer and mathematician who was knighted for his contributions to science, makes the following comment on the subject:

> **If there were a basic principle of matter which somehow drove organic systems toward life, its existence should easily be demonstrable in the laboratory.** One could, for instance, take a swimming bath to represent the primordial soup. Fill it with any chemicals of a non-biological nature you please. Pump any gases over it, or through it, you





Prof. Fred Hoyle

please, and shine any kind of radiation on it that takes your fancy. Let the experiment proceed for a year and see how many of those 2,000 enzymes [proteins produced by living cells] have appeared in the bath. I will give the answer, and so save the time and trouble and expense of actually doing the experiment. You will find nothing at all, except possibly for a tarry sludge composed of amino acids and other simple organic chemicals. [76]

Actually, materialism is in an even worse dilemma. Matter cannot even form life when combined with human knowledge and time, let alone form it by itself.

The truth that we have briefly glanced at is the truth that matter cannot form design and knowledge by itself. Yet the universe and the living things in it contain extraordinarily complex design and knowledge. That shows us that this design and knowledge in the universe and living things are the works of a Creator Who possesses infinite power and knowledge, Who existed before matter and rules it.

If we look carefully, this is an entirely scientific conclusion. It is not a "belief," but a truth acquired through observation of the universe and living things in it. That is why the evolutionists' claim that "Evolution is scientific, whereas creation is a belief that cannot enter the domain of science" is a superficial deception. It is true that in the nineteenth century materialism was confused with science, and that science was led off course by materialist dogma. However, subsequent developments in the twentieth and twenty-first centuries have completely over-



The cover of the July 27, 1998, "Science Finds God" edition of *Newsweek*.

thrown that hoary old belief, and the truth of creation, that had been concealed by materialism, has finally emerged. As the banner headline "Science Finds God," used by the famous magazine *Newsweek* in its historic July 27, 1998, edition makes clear, behind all the materialist deception, science finds God, the Creator of the universe and all that is in it.

THEY SAID, "GLORY BE TO YOU! WE HAVE NO KNOWLEDGE EXCEPT WHAT YOU HAVE TAUGHT US. YOU ARE THE ALL-KNOWING, THE ALL-WISE."
(QUR'AN, 2: 32)

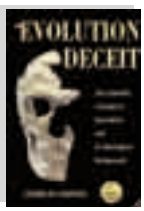
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Also by Harun Yahya



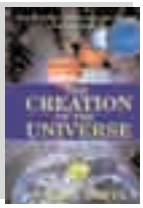
Many people think that Darwin's Theory of Evolution is a proven fact. Contrary to this conventional wisdom, recent developments in science completely disprove the theory. The only reason Darwinism is still foisted on people by means of a worldwide propaganda campaign lies in the ideological aspects of the theory. All secular ideologies and philosophies try to provide a basis for themselves by relying on the theory of evolution. This book clarifies the scientific collapse of the theory of evolution in a way that is detailed but easy to understand. It reveals the frauds and distortions committed by evolutionists to "prove" evolution. Finally it analyzes the powers and motives that strive to keep this theory alive and make people believe in it. Anyone who wants to learn about the origin of living things, including mankind, needs to read this book.



When a person examines his own body or any other living thing in nature, the world or the whole universe, in it he sees a great design, art, plan and intelligence. All this is evidence proving God's being, unit, and eternal power. *For Men of Understanding* was written to make the reader see and realise some of the evidence of creation in nature. *For Men of Understanding* is also available in Indonesian, German, French, Urdu and Russian.



How was matter and time created from nothingness? What does the Big Bang theory signify about the creation of the universe? What is the parallelism between Einstein's Theory of Relativity and the Qur'anic verses? All of these questions are answered in this book. If you want to learn the truths about space, matter, time and fate, read this book.



Today, science has proven that the universe was created from nothing with a Big Bang. Moreover, all physical balances of the universe are designed to support human life. Everything from the nuclear reactions in stars to the chemical properties of a carbon atom or a water molecule, is created in a glorious harmony. This is the exalted and flawless creation of God, the Lord of All the Worlds. *The Creation of the Universe* is also available in French, Russian and Indonesian.



Fascism and communism, which made humanity suffer dark times, are fed from the same source, on the grounds of which they can attract masses to their side. This source is the materialist philosophy and its adaptation to nature, which is Darwinism. The acknowledgement of the scientific invalidity of this theory will bring about the end of all these detrimental ideologies. This book is also available in French.



People who are oppressed, who are tortured to death, innocent babies, those who cannot afford even a loaf of bread, who must sleep in tents or even in streets in cold weather, those who are massacred just because they belong to a certain tribe, women, children, and old people who are expelled from their homes because of their religion… Eventually, there is only one solution to the injustice, chaos, terror, massacres, hunger, poverty, and oppression: the values of the Qur'an.



This book gets into detail on the issue of origins and makes a comprehensive and technical refutation of Darwinist theory. As it is mentioned in the book, anyone who still defends the theory of evolution has to come into terms with this book and face its challenge. Otherwise, he will de facto accept that his allegiance to the theory of evolution is a non-scientific approach but a materialistic dogma.



Many societies that rebelled against the will of God or regarded His messengers as enemies were wiped off the face of the Earth completely... Perished Nations examines these penalties as revealed in the verses of the Quran and in light of archaeological discoveries. This book is also available in German, French, Spanish, Russian, Indonesian and Portuguese.



In a body that is made up of atoms, you breathe in air, eat food, and drink liquids that are all composed of atoms. Everything you see is nothing but the result of the collision of electrons of atoms with photons. In this book, the implausibility of the spontaneous formation of an atom, the building-block of everything, living or non-living, is related and the flawless nature of God's creation is demonstrated. *The Miracle in the Atom* is also available in Indonesian.



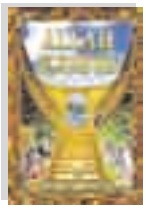
Man is a being to which God has granted the faculty of thinking. Yet a majority of people fail to employ this faculty as they should… The purpose of this book is to summon people to think in the way they should and to guide them in their efforts to think. This book is also available in Indonesian.



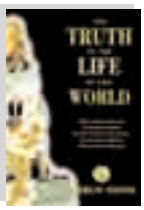
Darwin said: "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down." When you read this book, you will see that Darwin's theory has absolutely broken down, just as he feared it would. A thorough examination of the feathers of a bird, the sonar system of a bat or the wing structure of a fly reveal amazingly complex designs. And these designs indicate that they are created flawlessly by God. The book is also available in Russian.



Never plead ignorance of God's evident existence, that everything was created by God, that everything you own was given to you by God for your subsistence, that you will not stay so long in this world, of the reality of death, that the Qur'an is the Book of truth, that you will give account for your deeds, of the voice of your conscience that always invites you to righteousness, of the existence of the hereafter and the day of account, that hell is the eternal home of severe punishment, and of the reality of fate.



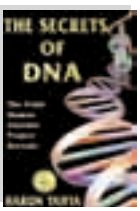
The plan, design, and delicate balance existing in our bodies and reaching into even the remotest corners of the incredibly vast universe must surely have a superior Creator. Man is unable to see his Creator yet he can nevertheless grasp His existence, strength, and wisdom by means of his intellect. This book is a summons to think. A summons to ponder over the universe and living beings and see how they have been created flawlessly.



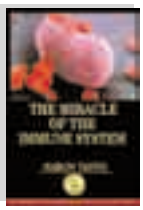
The world is a temporary place specially created by God to test man. That is why, it is inherently flawed and far from satisfying man's endless needs and desires. Each and every attraction existing in the world eventually wears out, becomes corrupt, decays and finally disappears. This is the never-changing reality of life. This book explains this most important essence of life and leads man to ponder the real place to which he belongs, namely the Hereafter.



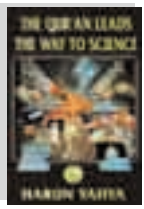
In this book you will find explanations about eternity, timelessness and spacelessness that you will never have encountered anywhere else and you will be confronted by the reality that eternity has already begun. The real answers to many questions people always ponder such as the true nature of death, resurrection after death, the existence of an eternal life, and the time when all these things will happen are to be found here…



Scientific progress makes it clear that living beings have an extremely complex structure and an order that is too perfect to have come into being by accident. Recently, for example, the perfect structure in the human gene became a top issue as a result of the completion of the Human Genome Project. In this book, the unique creation of God is once again disclosed for all to see.



When the events of "sickness" and "recovering" take place, our bodies become a battleground in which a bitter struggle is taking place. Microbes invisible to our eyes intrude into our body and begin to increase rapidly. The body however has a mechanism that combats them. Known as the "immune system", this mechanism is the most disciplined, most complex and successful army of the world. This system proves that the human body is the outcome of a unique design that has been planned with a great wisdom and skill. In other words, the human body is the evidence of a flawless creation, which is the peerless creation of God. This book is also available in Indonesian.



The way to examine the universe and all the beings therein and to discover God's art of creation and announce it to humanity is "science". Therefore, religion adopts science as a way to reach the details of God's creation and therefore encourages science. Just as religion encourages scientific research, so does scientific research that is guided by the facts communicated by religion yield very repid and definite results. This is because religion is the unique source that provides the most correct and definite answer to the question of how the universe and life came into being. This book is also available in Russian.



The plan, design, and delicate balance existing in our bodies and reaching into even the remotest corners of the incredibly vast universe must surely have a superior Creator. Man is unable to see his Creator yet he can nevertheless grasp His existence, strength, and wisdom by means of his intellect. This book is a summons to think. A summons to ponder over the universe and living beings and see how they have been created flawlessly. The book is also available in Urdu, French and Indonesian.



Colours, patterns, spots even lines of each living being existing in nature have a meaning. An attentive eye would immediately recognise that not only the living beings, but also everything in nature are just as they should be. Furthermore, he would realise that everything is given to the service of man: the comforting blue colour of the sky, the colourful view of flowers, the bright green trees and meadows, the moon and stars illuminating the world in pitch darkness together with innumerable beauties surrounding man. This book is also available in Arabic and Indonesian.



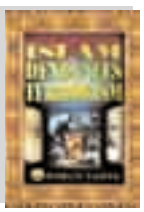
The information hidden inside DNA controls the thousands of different events that take place in the cells of the human body and in the functioning of its systems, as well as all the physical features, from the colour of a person' s hair and eyes to his height. In the same way that every book has a writer and owner, so does the information in DNA: and that Creator is our Lord God, the All-Wise.



Just as a tiny key opens a huge door, this book will open new horizons for its readers. And the reality behind that door is the most important reality that one can come across in one's lifetime. Relating the amazing and admirable features of spiders known by few people and asking the questions of "how" and "why" in the process, this book reveals the excellence and perfection inherent in God's creation.



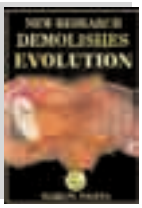
These millimeter-sized animals that we frequently come across but don't care much about have an excellent ability for organization and specialization that is not to be matched by any other being on Earth. These aspects of ants create in one a great admiration for God's superior power and unmatched creation. The book is also available in Urdu and Indonesian.



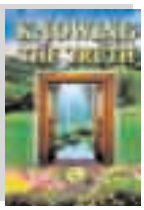
This book maintains that the source of the scourge of terrorism does not come from a divine religion, and that there is no room for terrorism in Islam. It is revealed, in the light of the verses of the Koran and with examples from history, that Islam forbids terrorism and aims to bring peace and security to the world. *Islam Denounces Terrorism* is also available in German.



The purpose of this book is to display the miraculous features of plants and hence to make people see "the creation miracle" in things -they often encounter in the flow of their daily lives and sidestep. This book opens new horizons on these issues for people who, throughout their lives, -think only about their own needs and hence fail to see the evidence of God's existence. Reading and understanding this book will be an important step in coming to an understanding of one's Creator.



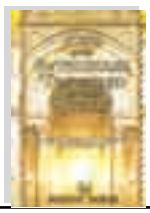
This book deals with how the theory of evolution is invalidated by scientific findings and experiments in a concise and simple language.



"Everything that constitutes our life is a totality of perceptions received by our soul. The things, people, places and events that make our world and our lives meaningful are like a dream; we perceive them only as images in our brain, and have nothing to do with their truth or reality…" In the book, which consists of a conversation between four people, the prejudices that prevent people from understanding this great truth are removed, and the misconceptions they have are explained.



The unprecedented style and the superior wisdom inherent in the Qur'an is conclusive evidence confirming that it is the Word of God. Apart from this, there are a number of miracles verifying the fact that the Qur'an is the revelation of God, one of them being that, 1,400 years ago, it declared a number of scientific facts that have only been established thanks to the technological breakthroughs of the twentieth century. In this book, in addition to the scientific miracles of the Qur'an, you will also find messages regarding the future. *Mracles of the Qur'an* is also available in Serbo-Croat (Bosnian), Chinese and Russian.



This book is about the enthusiasm of believers that keeps growing until the end of their lives. The main aim of the book is to increase the enthusiasm of believers showing them what a great blessing enthusiasm is, and how it enhances the power of believers.



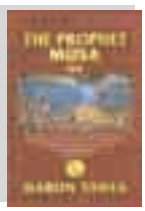
The content of this book is an extremely important truth that astounded large numbers of people, and caused their outlook on life to change drastically. We can sum up this reality like this: "All events, people, buildings, cities, cars, places, which are a part of our life in this world, in short, everything we see, hold, touch, smell, taste and hear, are actually illusions and sensations that form in our brain."



In societies distant from religion, right is often presented as wrong, and vice versa. Unbecoming behaviour which will not please God may be favoured and encouraged. Romanticism is one of those wrong sentiments which is assumed to be "right". This book reveals what a serious threat romanticism – which is imagined to be a simple character trait – poses to societies and individuals, and shows how easy it is to eliminate this danger.



Fascism is an ideology that has brought great disasters to humanity. Not only has it caused millions of people to be killed and tortured simply because of their race, but it has also attempted to abolish all human values. The main purpose of the book is to present various fascist tendencies which appear under different methods and guises, and expose their real origins and objectives. The book also attempts to tear down the mask of fascism, and reveal that fascism is definitely an anti-religionist system.



Moses is the prophet whose life is most narrated in the Qur'an. The Qur'an provides a very detailed account of his struggle with Pharaoh, the unfavourable conduct of his people and the way the Prophet Moses summoned them to the way of God. This book provides a thorough examination into the life of the Prophet Moses in the light of the Qur'anic verses.



A Muslim's life is described as follows in the Qur'an: "Truly, my prayer and my worship, my life and my death, are (all) for God" (The Qur'an, 6:162) A believer who decides to live for the cause of God must abandon all the idols of the society of ignorance *Devoted to God* is a summons to overthrow these idols for good.



One of the principal deceptions that impel people into delinquency is the fact that they constantly forget the basic facts of life. This book summons man to remember facts that his soul prompts him to forget.



In the Qur'an, God tells people many secrets. People who are unaware of these secrets experience the trouble and distress caused by this throughout their lives. For those who learn these secrets of the Qur'an, however, the life of this world is very easy, and full of joy and excitement. This book deals with the subjects God related to people as a secret.



God, in the Qur'an, calls the culture of people who are not subject to the religion of God "ignorance." Only a comparison of this culture with the honourable thoughts and moral structure of the Qur'an can reveal its primitive and corrupted nature. The purpose of this book is to take this comparison further, displaying the extent of the "crude understanding" of ignorant societies.



God createsevery word one utters, and every event one experiences, from the moment one is born into tis world. For a believer who understands this fact, uninterrupted joy of faith becomes an unchanging quality of life. The fate decreed by God is flawless.



There are questions about religion that people seek answers to and hope to be enlightened in the best way. In these booklets, you will find the most accurate answers to all the questions you seek answers for and learn your responsibilities towards your Creator.



One of the principal deceptions that impels people into delinquency and makes them pursue their own desires is their heedlessness of death. Both human beings and the universe they live in are mortal. What awaits the disbelievers in the next world is more dreadful: the eternal wrath of hell. This book, based on the verses of the Qur'an, makes a detailed depiction of the moment of death, the day of judgement, and the penalties in hell, and it sounds a warning about the great danger facing us.



You, too, would like to live in a peaceful and secure society where people live in harmony and friendship. However just waiting for such a world to come about by itself one day is of no use. This book is a summons to those who want goodness to prevail: it calls on them to do goodness and to form an alliance with other good people like themselves.



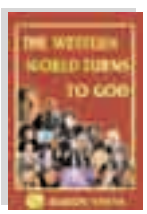
The Qur'an has been revealed to us so that we may read and ponder. The Basic Concepts of the Qur'an is a useful resource prepared as a guide to thinking.



Based on the information conveyed in the Qur'an, this book gives an account of God's attributes, our purpose in this world, what we have to do to fulfill this purpose.



This book introduces the real concept of conscience that is related in the Qur'an and draws our attention to the kind of understanding, thought, and wisdom that a truly conscientious person has.



Western societies suffered from all kinds of spiritual and material torments brought about by the materialist mentality throughout. Finally, however, they have come to realize that the only way to be saved from this dreadful life is turning to God. This book welcomes this development and gives an account of world-renowned politicians and celebrities who have turned towards religion and God.



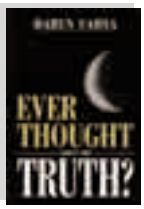
The purpose of this book is to inform people of the effect that Harun Yahya's works, from his books to the documentary films based on them, have had throughout the world.



In the Qur'an, there is an explicit reference to the "second coming of the Jesus to the world" which is heralded in a hadith. The realisation of some information revealed in the Qur'an about Jesus can only be possible by Jesus' second coming…



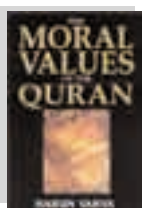
In order for justice to reign on the Earth, a morality that will make people leave their own interests aside in favour of justice is needed. This morality is the Qur'anic morality that God teaches and commands us.



The most serious mistake a man makes is not pondering. It is not possible to find the truth unless one thinks about basic questions such as "How and why am I here?", "Who created me?", or "Where am I going?."



That people do not adopt the moral values of the Qur'an and submit to God underlie the personal and social depression, pain, fears and lack of confidence that is widely experienced today. This book explains the detriments that disbelief gives to people.



A study that examines and seeks to remind us of the basic moral principles of the Qur'an, particularly those that are most likely to be forgotten or neglected at times. This book is also available in Bengoli.



The Qur'an has been sent down as a book easily understandable by everyone. In this book, the reasons why those people misinterpret the Qur'an are examined and some examples of the objections they make are reviewed and answered.



In this book, all ideologies based on disbelief are referred to as "the religions of irreligion." That is simply because these ideologies have in time evolved to become religions with a complete system of beliefs, practices, and rules for conducting one's daily life.



The purpose of this book is to warn people against the day on which they will say "If only we did not rebel against God. If only we listened to the messengers…" and therefore feel deep regret.

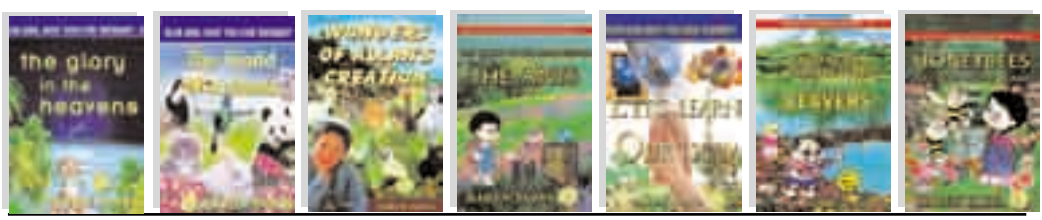


This is a book you will read with pleasure and as it makes explicitly clear why the theory of evolution is the greatest aberration in the history of science.

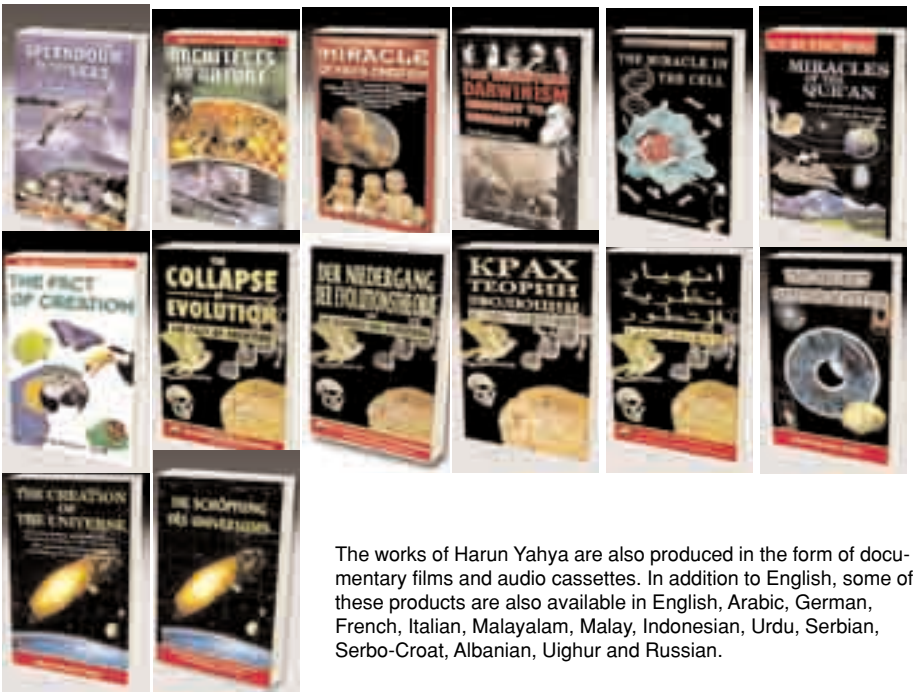


This booklet, includes summaries of all the works of Harun Yahya. Anyone who reads these books seriously and carefully will soon gain a deep insight into the true nature of the world he lives in.

CHILDREN'S BOOKS



VIDEO FILMS



The works of Harun Yahya are also produced in the form of documentary films and audio cassettes. In addition to English, some of these products are also available in English, Arabic, German, French, Italian, Malayalam, Malay, Indonesian, Urdu, Serbian, Serbo-Croat, Albanian, Uighur and Russian.

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The works of Harun Yahya are also produced in the form of documentary films and audio cassettes. In addition to English, some of these products are also available in English, Arabic, German, and Russian.

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